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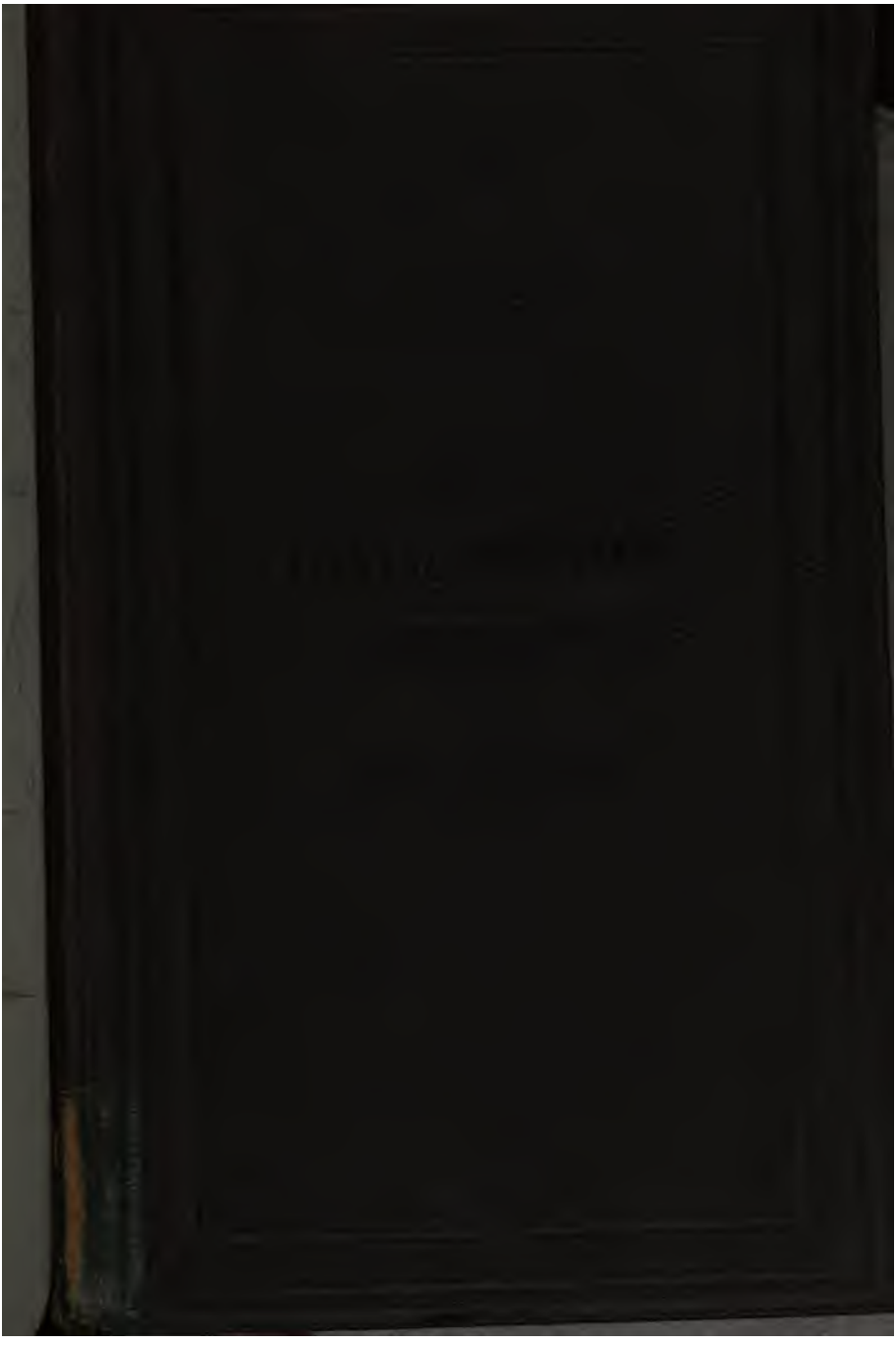
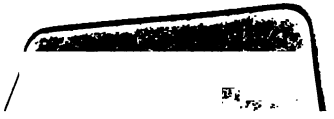




A KEY

TO THE

CIVIL SERVICE ARITHMETIC.

BY

R. JOHNSTON, F.R.G.S.

New Edition.

LONDON:
LONGMANS, GREEN AND CO.

1879.

181. g. 172*

A KEY

TO THE

CIVIL SERVICE ARITHMETIC.

IV.

(7)

8679 × 23 = 199617 *Ans.*

8679 × 4 = 34716; 34716 × 7 = 243012 *Ans.*

(8)

76979 × 8 = 615832 prod. by 8.

615832 × 6 = 3694992 *Ans.*

615832 × 7 = 4310824 *Ans.*

(9), (10), (11), (12), are worked in the same way.

(13)

778690 = prod. by 10

778690 × 8 = 6229520 = prod by 80

6229520 × 7 = 43606640 *Ans.*

2nd part in usual way.

(14) 75060 × 914 = 68604840

300240

75060

675540

(15)

93786000 prod. by 100

93786000 × 12 = 1125432000 „ 1200

1125432000 × 8 = 9003456000 *Ans.*

2nd part

844074000 prod. by 900

844074000 × 7502880 = 851576880 *Ans.*

„ 8

again 75060 × 1000 = 75060000 ·

and 75060 × 30 = 2251800; then take second prod. from the first.

(16)
207019
19307
1449133
621057
1863171
207019
3996915833 *Ans.*

82807600 = prod. by 400
from which take prod.
by 10.

(17)
20136720
215670
1409570400 prod. by 70
112765632000 „ 5600 = 80 × 70
4228711200000 „ 210000 = 3000 × 70
4342886402400 *Ans.*

18)
407079
604807
2849553 = prod. by 7
1709731800 = „ 4200 = 7 × 600
244247400 = „ 600
2442474 = „ 600000
246204228753000 *Ans.*

(19)
9940806
977306
59644836
29822418
69585642
69585642
89467254
97152093486360 *Ans.*

(20)
704896
704098
5639168
6344064
2819584
4934272
496315863808000 *Ans.*

(21)
9607587
94806
57645522
461164176 = 6 × 800
86468283 = prod. by 90000
910856893122 *Ans.*

(22), (23), (24), (25), and (26), very easy.

(27)
6405900800 = prod. by 100
384354048 = „ 6
4612248576 = 120000 × 6
46129276014848 *Ans.*

(28) Annex 00, and subtract 6 times the multiplicand (29) see 19, p. 2; (30) multiply by 80, and take away twice the multiplicand; (31) mark that $20 \times 300 = 6000$; (32) work like 30; from 33 to 38 give no difficulty.

V.

(1), (2), (3), are as easy as the examples.

(4) 23)70633(3071 *Ans.*

69

163

161

23

23

4)70633

6)17658..1

2943..1

(5), (6), (7), (8), (9), (10), (11), (12), (13), (14), and (15) exhibit no difficulty.

(16) 652)630762540981(967427210$\frac{61}{652}$ *Ans.*

5868

4396

3912

4842

4564

2785

2608

1774

1304

4700

4564

1369

1304

658

652

61

(17) The divisor and dividend being even numbers, we divide both by 2.

413)375162049088(908382685$\frac{183}{413}$ *Ans.*

3717

3462

3304

1580

1239

3414

3304

1109

826

2830

2478

3528

3304

2248

2065

183

(18) 93)237056

1860(25484

510 *Ans.*

465

450

372

785

744

416

372

44 rem.

(19), (20), (21), and (22) do not require a solution.

(23), use the factors 6×7 and 9×9.

(24), use the factors 12×9 and 11×11.

(25), the divisor $385 = 5 \times 77 = 5 \times 7 \times 11$

(26) „ $648 = 8 \times 81 = 8 \times 9 \times 9$

(27) „ $792 = 8 \times 99 = 8 \times 9 \times 11$

(28), (29), (30), see Exs. (5), (6), and (7)

(31) $968645 \div 25 = 3874580 \div 100 = 38745\frac{80}{25}$ *Ans.*

$968645 \div 35 = 193729 \div 7 = 27675\frac{20}{35}$ *Ans.*

(32) $897895 \div 60 = 179579 \div 12 = 14964\frac{11}{12}$ *Ans.*

$897895 \div 125 = 7183160 \div 1000 = 7183\frac{160}{125}$ *Ans.*

(33), see (31); (34), see 31 above.

(35)

	97688		97688
	20		6
	1953760 prod. by 20.		586128
$\frac{1}{2}$ of 97688 =	48844 „	$\frac{1}{2}$	6
	1904916 *Ans.*		3516768
		$\frac{1}{2}$ =	48844
			3565612 *Ans.*

(36)

	86408		86408
	5		$86\frac{3}{4}$
	432040		518448
	9		691264
	3888360	$\frac{1}{2}$ =	43204
$1\frac{1}{4} = \frac{1}{4}$ of 5 =	1080010	$\frac{1}{2}$ of 43204 =	21602
	3988370 *Ans.*		7495894 *Ans.*

(37) $86976 \div 9\frac{1}{2}$ and by $25\frac{1}{2} = 173952 \div 19$ and by 51

(38) $79684\frac{1}{4} \div 6\frac{3}{4}$ and by $29\frac{1}{4} = 318737 \div 27$ and 117

VI.

(1) 90708 + 16013 = 272124

90708 × 544248

90708 × 1452507204 + 99 = 1452507303 *Ans.*

(2) 13009 + 9016 = 78054

13009 × 117081

117289144 − 998 = 117288146 *Ans.*

(3) 7896 + 8908 = 16804

11)16804

$1527\frac{7}{11}$ *Ans.*

(4), (5), (6), (7), and (8), are just as easy as the preceding.

(9) 9603 + 1067 = 10670 sum.

9603 − 1067 = 8536 diff.

1067 × 9603 = 10246401 product.

1067)9603(9 quotient.
9603

(10) $389455 \div 365 = 1067$ *Ans.*

(11) 72 + 24 = 96; 72 + 24 = 96; 24)72(3
72

$96 \times 48 \times 72 \times 24 \times 3 = 23887872$ *Ans.*

(12) $347 \times 49 \div 27 = 17030$ *Ans.*

(13) 1860 was a leap year.

Jan.	31
Feb.	29
March	31
April	30
May	31
	152 *Ans.*

(14) From Jan. 20, 1857, to Jan. 26, 1863
$= 365 \times 6 + 1$ leap year $= 2191$ days.
From Jan. 20 till August 14 $= 206$ days.
$\therefore$ *Ans.* $= 2191 + 206 = 2397$ days.

(15), (16), (17), (18), and (19) are as simple as the Examples.

(20) From 25*s.*
Take 3*s.*
2)22*s.*
11*s.* share of the one.
and $11 + 3 = 14s.$ „ the other.

(21) $1110 \div 37 = 30$ *Ans.*

(22) $17 \times 93 \times 46 \times 59 = 4290834$
$227 \times 247 \times 58 = 3252002$
1038832

(23), (24), and (25), are still easier than (22).

VII. (*a*)

(1) The chief use of the 0 is to supply the place of significa figures.

(2) 9017059096: seven thousand one hundred and six m lions, five hundred and ninety-seven thousand and forty-eight.

(3) $\frac{1135-189}{2} = \frac{946}{2} = 473$ who voted for one; a $473 + 189 = 662$ number who voted for the other.

(4) Divide the difference by 9.

(5) Having added all the numbers together, multiply the su by $1\frac{3}{4}$, as in V. (36).

(6) Divide the number of seeds by 2, and multiply the qu tient by the number of years, and this result by the number elms.

(*b*)

(1) See definitions given in Treatise.

(2) Use V., Ex. (15) in the operation.

(3) Add the second and third, and take the sum from t first.

(4) See those Tables.

(5)
41033
2059
38974
19080
58054 + 11 = 638594 = *Ans.*

(6)
7649
697
5073
719
838
24
6
144
12)14976
12)1248
104 *A*

(*c*)

(1) Too simple to be solved here.

(2) The answer is a sufficient solution.

(3)
```
42)7890567(187870
  42
 369
 336
 330
 294
 365
 336
 296
 294
  27 rem.
```

```
6)7890567
7)1315094+3
  187870+27 rem.
  [rem. = 6 × 4+3]
187870 × 42+27 = 7890540+27
       = 7890567 proof.
```

(4) Multiply 13 by 33, and divide the product into 9867.

(5)
```
          2360
7 dozen =   84
19)2276(119
   19
   37
   19
  186
  171
   15 over.
```

```
2,0)236,0
   118
```

(6)
```
4 9 5)9 2 0 7 0 0 0 0
  9 9)18414000
  11)2046000
      186000 Ans.
```

(*d*)

(1) Very simple.

(2)
```
33 { 3)1221000000
   {11)407000000
     37000000 die every year.
     32937487 British Isles.
      4062513 Ans.
```

(3) See VI. (20)

(4) See V. (36.)

(5) He walks each day $9\frac{1}{2} \times 3 = 28\frac{1}{2}$ miles.

$28\frac{1}{2} \times 29 \times 313 = 258694\frac{1}{2}$ *Ans.*

(6) See V., Ex. (15).

(*e*)

(1) 949736018
4097080
75978881440
6648152126
8547624162
3798944072
3891144446627440 *Ans.*

(2) Divide 99 times the difference by the given number, 78074.

(3) Sherry = £2 × 14 × 12 = £336
Claret = £3 × 3 × 52 = £468
Port = £2½ × 3 × 26 = £195
£999
∴ 1000 − 999 = £1 *Ans.*

(4) 78967, 139753, 145069, 363789
∴ Population of 4th and 5th = 758043 − 363789 = 394254
∴ *Ans.* = 394254 ÷ 2 = 197127

(5) (87 × 15 + 69 × 9) × 60 = 115560 number of beats in a day.
Ans. = 115560 × 7 = 808920.

(6) See note, p. 25 in Arithmetic, and (*c*) (3), above.

(*f*)

(1) As easy as the Examples in the Rule.

(2) $a = 113 - 39 = 74$
$b = 75 + 6 = 81$
$c = 189 - 133 = 56$
$d = 42 + 153 = 195$
$e = 10 + 73 - 4 = 79$
$48\frac{1}{2}$) 485
2 2
97) 970 (10 *Ans.*

(3) See V., Exs. (I4) and (15)

(4) In 1868 letters were delivered on 312 days.
∴ *Ans.* = (808117968 − 774831000) ÷ 312 = 23286968 ÷ 312 = 106689

(5) Monday = 2 other days and Sunday = ½ another; therefore there were $7\frac{1}{2}$ times an ordinary daily delivery.

$$\therefore \text{ordinary daily delivery} = \frac{8505}{7\frac{1}{2}} = \frac{17010}{15} = 1134$$

$$\therefore \textit{Ans.} = 1134 \times 2 = 2268.$$

(6) Had 50 been killed out of each of the two armies both would have remained equal. ∴ 400 more being killed out of one than out of the other, caused that one to be only *half* the other. ∴ Strength of this one after the battle = 400 × 2 = 800; and before it = 850.

VIII.

(1) 15 *guins.*
21
15
30
315*s.*
12
3780*d.*
4
15120*f Ans.*

(2) See Ex. (6), above.

(3) and (4), See Ex. (2), above.

(5) See Ex. (6), above.

(6), (7), and (8), See Ex. (2), above.

(9) and (10), See Ex. (3), above.

(11) 159 qrs.
8
1272 bu.
4
5088 pks.
2
10176 galls.
4
40704 qrts. *Ans.*

(12) 34 lbs. 10 oz. 12 dwts.
12 [16 grs.
418 oz.
20
8372 dwts.
6
50232
4
200944

(13) 3 a. 20 rods. 12 sq. yds. [7 sq. ft.
4
12 roods.
40
500 rods.
30½
15012
125
15137 sq. yds.
9
36240 sq. ft. *Ans.*

(16) See Ex. (3), above

(17) 3 wks. 4 days 5 hrs. 54′
7
25 days.
12
300
2
605 hrs.
60
36354′
60
2181240″ *Ans.*

(18) 13 yds. 7 ft. 19 in.

9

124 ft.

12

1488

12

17875 in.

(19) See (18), above.

(20) See Ex. 6, above.

(21) See (12), above.

(22) See Ex. 2, above.

(23) See Ex. 1, above.

(24) See Ex. (12), above

(25) See Ex. 2, above.

(26) See Ex. 1, above.

(27) 375 cwt. 2 qrs. 1st. 13lbs.

4

1502 qrs.

2

3005 stones.

14

42083 lbs.

16

673328 oz. *Ans.*

(28) See Ex. 6, above.

(29) See (12), above.

(30) 42 wks. $8\frac{1}{4}$ hrs. $15\frac{1}{2}$ m. 5 secs.

7

294 days.

2 $\quad 24 = 2 \times 12$

588

12

$7064\frac{1}{4}$ hrs.

60

$423855\frac{1}{2}$

$\frac{1}{4}$ of 60 = 15

$423870\frac{1}{2}'$

60

25432235

(31) 35 days 8 hrs. 48′ 29″

24

848 hours.

60

50928′

60

3055709″ *Ans.*

IX.

(1) See Ex. 1, above.

(2) See Ex. 2 above.

(3)
4)523769 grs.
6) 130942..1
2,0) 2182,3..4 } 17
12) 1091..3
90 lbs. 11 oz. 3 dwts. 17 grs. *Ans.*

(4)
9) 569705 sq. ft.
63300··5
$30\frac{1}{4}$ 4
4 { 11) 253200
121 { 11) 23018..2
4,0) 209,2..6 } $\frac{6\,8}{4} = 17$
4) 52..12
13 ac. 12 pls. 17 yds. 5 ft. *Ans.*

(5)
6,0) 2933693,5″
6,0)48894,8..55
24 { 6) 8149..8
4) 1358..1 } 13
7) 339..2
48 wks. 3 days 13 hrs. 8 m. 55 secs. *Ans.*

(6) See (3), above.

(7)
12) 348164 in.
3) 29013..8
9671
2
11)19342
4,0) 1758
8) 43..38
5 mls. 3 fur. 38 pls. 2 yds. 8 in.

(8) See Ex. 2, above.

(9) See (5), above,

(10) See Ex. 3, above.

$\frac{4}{2} = 2$ yds.

(11)
12) 150000
12) 12500 doz.
1041 gross 8 doz. *Ans.*

(12) See (4), above.

(13) See (3), above.

(14) See Ex. 2, above.

(15) See (7), above.

(16) 12)247391 in.
3)20615..11
6871..2
2
11)13742 half-yds.
4,0)124,9
8)31..9

$\frac{3}{2}$ = 1 yd. 1 ft. 6 in.
2 11

3 mls. 7 fur. 9 pls. 2 yds. 1 ft. 5 in. *Ans.*

(17) See (3), above.

(18) 12)657918 c. in.
12)54826 .. 6
12)4568 .. 10
3)380 .. 8 × 144 = 1152
9)126 .. 2 1278
14 yds. 2 ft. 1278 in. *Ans.*

(19) See (18), above.

(20) See (16) above.

(21) See Ex. (2) above.

(22) See (18) above.

(23) Number of *fourpenny-pieces* = 37689 × 3 = 113067.

(24) See (23), above

(25) Number of *half-sovs.* = $\frac{7642 \times 21}{10}$ = 16048 and 2*s.*

(26) Number of nls. = 564 × 5 × 4 = 11280.

(27) See Ex. (1), above

(28) 3) 250
2,0) 8,3 4
£4 3 4
14 3
£4 17 7 *Ans.*

4) 57
14*s.* 3*d.*

(29) *Number of* labourers = $\frac{35 \times 21}{2\frac{1}{2}} = \frac{\overset{7}{\cancel{35}} \times 21 \times 2}{\cancel{5}} = 294$ *Ans.*

XII.

(1), (2), (3), (4), (5), and (6), see Ex. (1).

(7)

£	s.	d.
709	19	$7\frac{1}{2}$
		8
5679	17	0
		3
17039	11	0 *Ans.*

£	s.	d.
709	19	$7\frac{1}{2}$
		8
6389	16	$7\frac{1}{2}$
		3
19169	9	$10\frac{1}{2}$ *Ans.*

(8), (9), (10), (11), (12), see (7), above.

(13)

£	s.	d.
568	9	$10\frac{1}{4} \times 5$
		8
4547	18	10
		8
36383	10	8
2842	9	$3\frac{1}{4}$
39225	19	$11\frac{1}{4}$ *Ans.*

£	s.	d.
568	9	$10\frac{1}{4} \times 2$
		8
4647	18	10
		9
40931	9	6
1136	19	$8\frac{1}{2}$
42068	9	$2\frac{1}{2}$ *Ans.*

£	s.	d.
336	17	$10\frac{1}{4} \times 5$
		10
3368	18	$6\frac{1}{2}$
		9
30320	6	$10\frac{1}{2}$
1684	9	$3\frac{1}{4}$
32004	16	$1\frac{3}{4}$ *Ans.*

£	s.	d.
336	17	10×2
		12
4042	14	3
		8
32341	14	0
673	15	$8\frac{1}{2}$
33015	9	$8\frac{1}{2}$ *Ans.*

(15) $137 = 12 \times 11 + 5$
$149 = 12 \times 12 + 5$

(16) $234 = 6 \times 4 \times 10 - 6$
$378 = 6 \times 8 \times 8 - 6$

(17)

ac.	r.	p.	
19	3	30	(3)
		12	
239	1	0	
		12	
2871	0	0	
59	3	10	
2930	3	10	Ans.

(18)

	a.	r.	p.	
(2)	23	1	16	(525 = 5 × 5 × 3 × 7)
			5	
	116	3	0	(19) 129 = 12 × 10+9
			5	
	563	3	0	(20) 729 = 9 × 9 × 9
			3	
	1751	1	0	(21) 709 = 10 × 10 × 7+9
			7	
	12258	3	0	(22) 999 = 10 × 10 × 10—1
	46	2	32	
	12212	0	8 *Ans.*	(23), (24), (25), and (26), ar simple.

(27)

£	s.	d.	
13	0	$11\frac{1}{2}$	(368 = 4 × 92)
		4	
52	3	10 × 2	(28), (29), (30), (31), (32), (3
		10	and (34), are very easy.
521	18	4	
		9	(35) 635 = 5 × 127
4697	5	0	= 8 × 8 × 10—5
104	7	8	
4801	12	6 *Ans.*	(36) 465 = 5 × 93.

XIII.

(1), (2), (3), (4), (5), and (6), see Ex. 1.

(7)

£	s.	d.		£	s.	d.	
8) 5698	17	6		7) 5698	17	6	
5) 712	7	$2\frac{1}{2}$		7) 814	2	6	
142	9	$5\frac{1}{4}$ *Ans.*		116	6	$0\frac{6}{7}$ *Ans.*	

(8) See (7), above.

(9)

£	s.	d.		£	s.	d.	
10) 7899	15	0		8) 7899	15	0	
4) 789	19	6		6) 987	9	$4\frac{1}{2}$	
9) 197	9	$10\frac{1}{2}$		9) 164	11	$6\frac{3}{4}$	
21	18	$10\frac{1}{2}$		18	5	$8\frac{3}{4}$	

(360 = 10 × 4 × 9) (432 = 8 × 9 × 6)

(10), (11), (12), see Exs. 3 and 4.

(13)

	c.	qrs.	lbs.	oz	drs.
10)	9006	3	20		
12)	900	2	21	9	9 + 6
	75	0	6	7	7 + 56 rem.

(14), (15), (16), (17), see (13), above, and Exs. 3 and 4.

(18)

£	s.	d.		£	s.	d.
3	12	6)		1794	7	6
20				20		
72				35887		
12				12		
87ø			87)	430656	(495 *Ans.*	
				348		
				826		
				783		
				435		
				435		

(19), (20), (21), (22), (23), see (18), above, and Exs. 5 and 6.

(24), (25), see Ex. 7.

(26)

	£	s.	d.	
10)	14075	10	6	
10)	1407	11	0½	+ 4 *f.*
8)	140	15	1¼	
	17	11	10½	504 *f.* rem. = 10*s.* 6*d.*

(27), (28), (29), (30), (31), (32), (33), are similar to several already worked.

(34) $19\frac{1}{2}$) £798 3 $10\frac{1}{2}$ (£409 8 11 *Ans.*

2 2

39) 15968 7 9

156

368

351

17

20

347

312

35

12

429

429

(35) $6\frac{3}{4}$ 4 27

£ s. d.

3) 6466 3 3

9) 2155 7 9

239 9 9 *Ans*

(36) £ s. d.

6) 2678492 15 6

3) 446415 9 3

148805 3 1 *Ans.*

(37) £ s. d.

47) 1748426 9 $8\frac{3}{4}$

£37200 11 $3\frac{1}{4}$ *Ans.*

(38), (39), (40), (41), see (35), and (37), above.

(42) £ s. d. £ s. d.

39 11 $9\frac{1}{4}$) 316470 16 $0\frac{1}{2}$

20 20

791 6329416

12 12

9501 75952992

4 4

38005) 303811980 (7994 *Ans.*

266035

377769

342045

357247

342045

152020

162020

(43) See (42), above.

(44) 1 tun. = 252 galls.; and £60 7*s.* 6*d.* ÷ 252 = 4*s.* 9½*d.* *Ans.*

(45)

	c.	qrs.	lbs.
3)	475	1	16
9)	158	1	24
	17	2	12 *Ans.*

(46)

	£	*s.*	*d.*
	32576	2	1
			4
	130304	8	4
			4
	521217	13	4
½ =	16288	1	0½
65)	537505	14	4½
	£8269	6	4½ *Ans.*

(47) See Ex. 10, &c., above.

(48)

40 lbs. 8 oz. 5 drs. 1 sc. 7 grains

12

488 oz.

8

3909 drs.

3

11728 sc.

20

234567 grs.

24 { 4) 234567 grs.
6) 58641 .. 3
2,0) 977,3 .. 15
12) 488 13 15
40 lbs. 8 oz. 13 drs. 15 grs.

(49)

12 m. square.

12

144 sq. miles.

640

5760

864

92160 acres.

(50) See Exs.

The sum of the two multipliers.

(51) See page 39 in Treatise.

(52) £74 2*s.* 10*d.* ÷ 328 = 4*s.* 6¼*d.* ∴ *Ans* = 6¼*d.*

(53) See Tables.

(54) See Ex. (4), above.

(55) (529 = 66 × 8+1)

qrs.	bu.	pk.
5	1	3 × 1
		8
41	6	0
		6
250	4	0
		11
2755	4	0
5	1	3
2760	5	4 *Ans.*

(56) to (67) inclusive, are very similar to the Examples given.

(68) 10 ac. 3 pls. 10¼ sq. yds.

4
40
40
1603
30¼
48100¼
400¾
48501
9
436509
12
5238108
12
62857296 *Ans.*

(69)

	pints.
2)	9503707
4)	4751853..1 pt.
2)	1187963..1 qt.
4)	593981..1 gal.
8)	148495..1
	18561..7..1..1..1..1
Ans.	qr. b. pk. g. q. p.

(70) and (71) are equally simple.

(72)

4*s.*	7½*d.*	
	6	
1	7	9
	7	
9	14	3
	10	
97	2	6 prod. by 420
½ of £1	7	9 = 13 10½
£96	8	7½ *Ans.*

(73) £2058 1*s.* 3*d.*
= 493935 pence;
and 3*s.* 3*d*;
= 39 pence
∴ 493935 ÷ 39
= 164645 ÷ 13
= 12665 cwts.
= 633 tons.
5 cwts. *Ans.*

(74) *888 = 74 doz.* and 74 @ 17*s.* 6*d.* = £741 ess 74 half erns.
= *£74*—£9 *5s.* = £64 15*s.* *Ans.*

(75) 3 mls. 2 f. 11 pls. 1 yd. 6 in. × 2

					6
19	5	27	1	1	6
					10
197	0	32	4	0	0
6	4	22	2	1	
203	5	15	0	2	6 *Ans.*

(76), (77), (78) are similar to the Examples.

(77) See Ex. 12 under XIII.

(78) See No. 69.

(79) 17) £6 12 5½ (7s. 9½d.

20

132

119

13

12

161

153

8½

2

17 (½

17

now 7s. 9½d.

10

3 17 11

11

42 17 1

½ of 7s. 9½d. = 3 10¾

£43 0 11¾

(80) Reduce 8 tons 4 lbs. to lbs., and divide into £466 15s. 5d.

(81) See Ex. 12 under XIII.

(82) Filling one out of 56 galls. is the same as filling 3 out of 3 times 56 or 168 gallons ∴ divide 168 gallons by 7 pints.

(83) Reduce ½ an acre or 2 roods to square yds. = 2420; and find the cost in the usual way.

(84) See Ex. 2, under IX.

(85) Here 67 ft. ÷ 6¼ inches = 804 ÷ 6¼ = 3216 ÷ 25 = 128 and 16 rem. which is 16 quarters = 4 in (see note, p. 21 in Treatise.)

(86) Since 18 miles 1 fur. 44 yds. = 31944 yds. and 8 rods = 44 yds. *Ans.* = 31944 ÷ 44 = 726.

(87) Number of articles bought = £65 3*s.* 4*d.* ÷ 68 = 230, then *Ans.* in pence = 230 × 2 = 460 = £1 18*s.* 4*d.*

(88) £3 16 6 a doz. = 6s. 4½d. each; now 6s. 4½d. × 29 = £9 4*s.* 10½*d.* *Ans.*

(89) Divide twice the dividend (£31) by twice the divisor.

(90) The income must in £'s. be = the number of fourpences in 23 *guineas*; ∴ 23 *guins.* or 5796d. ÷ 4 = £1449 *Ans.*

(18) $$\frac{30 \times 94}{8} = \frac{1410}{4} = 352\tfrac{1}{2} \text{ lbs.} = 25 \text{ st. } 2\tfrac{1}{2} \text{ lbs.}$$
(47 over 94; 8 over 4)

(19) See Ex. 5, p. 58 in Treatise.

(20) $$\frac{£26\ 12s.}{10s.\ 8d.} = \frac{}{} = 49 \text{ yds. } 3 \text{ qrs. } 2 \text{ nls. } \textit{Ans.}$$
(399 over 1596; 84 over 128; 32 over 8)

(21) Cost of 30 perches $= 20 \times 6\tfrac{1}{2}d. = 10s.\ 10d.$

Number of perches in 3 ac. $= 480.$

Now $480 \div 30 = 16$; $\therefore$ it will take 16 times the cost 30 pls. for cost of 3 ac. $\therefore$ Cost of 3 ac. $= 10s.\ 10d. \times 16$ £8 13*s.* 4*d.* *Ans.*

(22) See (5), above. (23) See X., Ex. 1.

(24) See VIII., Ex 5.

(25) $3 \times 3 \times 8 \times 40 \times 5\tfrac{1}{2} \times 3 \times 12 = 570240$ in. *Ans.*

(26) See VIII., Ex. 3. (27) See VIII., Ex. 2.

(28)

			15*s.* $6\tfrac{1}{2}d.$	price of 1 yd.
			8	
6	4	4	„	8 yds.
			4	
24	17	4	„	32 „
		7	$9\tfrac{1}{4}$	„ $\tfrac{1}{2}$ yd.
£25	5	$1\tfrac{1}{4}$	*Ans.*	

$\tfrac{1}{2}$ of 15*s.* $6\tfrac{1}{2}d.$ =

(29) and (30), See XII., Examples 4 and 5.

(31) See VIII., Ex. 6.

£	s.	d.	
1000	0	0	
982	14	$0\frac{1}{4}$	
17	5	$11\frac{3}{4}$	
		8	
138	7	10	
		7	
968	14	10	
17	5	$11\frac{3}{4}$	
£986	0	$9\frac{3}{4}$	*Ans.*

£	s.	d.	
19)986	0	$9\frac{3}{4}$	
£51	17	$11\frac{1}{4}$	*Ans.*

ee Ex. (9), above.

$$Ans. = \frac{£16\ 10s.\ 9d. \times 4\frac{1}{2}}{13\frac{1}{2}} = \frac{£5\ 10s.\ 3d.\ Ans.}{\cancel{16}\ \cancel{10}\ \cancel{9} \times \cancel{9} \times \cancel{2}}{\cancel{27} \times \cancel{2}}$$

See VIII., 27.

(8) See XIII., Ex. 5.

See X., Ex. 1.

(10) and (11), See Ex. 5.

See XIII., Ex. 3.

(13) See XIII., Ex. 5.

tons.	cwts.	qrs.	lbs.	
347	13	2	23	
39	15	3	25	
8) 307	17	2	26	
7) 38	9	2	24..4	
5	9	3	23	7 oz. $6\frac{6}{7}$ drs, *Ans.*

Income = 4*s.* 6d. × 365 + £2 6*s.* $10\frac{1}{2}d. \times 12$ = £110 5*s.*

$$Ans. = \frac{£17\ 10s.}{14d.} = \frac{\overset{600}{\cancel{42}\cancel{00}}}{\underset{2}{\cancel{14}}} = £300.$$

$$\frac{\overset{4}{\cancel{60}} \times 5}{\cancel{15}} = 20\ Ans.$$

(47) If we double the hour of the sun's rising we ge length of the night; if we double the hour of his setting w the length of the day. Hence, 24 hrs. – 3 hrs. 49′ 51 = 16 hrs. 20′ 18″ *Ans.* This is evidently an unfair quest

(48), (49), (50), and (51), See (35), above.

(52) Similar to several already worked.

(53) Circumference of wheel = $\frac{3\frac{1}{2} \times 1760}{1848} = \frac{7 \times 20}{21 \times 2} = 3$ yds

20
1ø0
1ø8
21

10
3

(54), (56) See VIII., Ex. 6.

(55) 12) 767914 sq. in.
12) 63992 .. 10 } 106
9) 5332 .. 8 }
592 sq. yds. 4 ft. 106 in.

(57), (58), (59), (61) very simple.

(60) 13 c. yds. 5 ft. 19 in.
27
96
26
356 ft.
12
4272
12
51264
12
615167 cub. inches.

(62) oz. drs.
1 13
5 0
90
12) 450 oz.
37½

(63) See IX., (16)

(64) See IX., Ex. 1.

(65) See VIII. (12)

(66) See IX., Ex. 2.

(67) See IX. (16).

(58), (69), See IX., Ex. 2.

(70) See IX. (5).

1) Use Table IX. (72) See XIII., Ex. 12.

3) 640 acres = 1 square mile.

4) 9 square feet = 1 square yard.

5) $\frac{329 \times 11}{8} = \frac{3619}{8} = 452$ qrs. 3 bus.; then 452 qrs. 3 bus. at 6*s.* 6*d.* per qr. = £147 0*s.* 5¼*d.* *Ans.*

6) On every £1 income he loses 4*d.* ∴ *Ans.* = £84 7*s.* 6*d.* ÷ 4*d.* = 20250 ÷ 4 = £5062 10*s.*

7) Divide the value of the gold by the price per ounce.

8) Use "Square Measure;" then find the value by Compound Multiplication.

9) Use "Avoirdupois Weight." (80) Use 13, worked above.

10) Here 200 × 5¼*d.* = 1050*d.* = £4 7*s.* 6*d.*; and £1 13*s.* 4*d.* ÷ 200 = 2d. ∴ *Ans.* 5¼*d.* + 2*d.* = 7¼*d.*

12) See "Troy Weight." (83) $\frac{£2857\ 15s. \times 2}{2s.\ 6d.} = 45724$ *Ans.*

14) Gain on each of the first = 4*s.* 10½*d.* — 3*s.* 6d. = 1*s.* 4½*d.*; and gain on each of the second = 4*s.* 4½*d.* — 3*s.* 7*d.* = 9¼*d.* ∴ *Ans.* = 1*s.* 4½*d.* × 758 + 9¼*d.* × 534.

15) See *Ex.* 5, page 34. (86) See *Note*, page 25.

17) They lose 16*s.* 8*d.* in every £1. ∴ 16*s.* 8*d.* × 9075½*d.* = £4562 18*s.* 4*d.* *Ans.*

18) Here £13 × 1408 — £6143 17*s.* 4*d.* = £12160 2*s.* 8*d.* Now, £12160 2*s.* 8*d.* ÷ 1408 = £8 12*s.* 8¾*d.*

19) Here 22 cwt. 2 qrs. = 2520 lbs.; and 2520 × 5*d.* = £52 10*s.* ∴ *Ans.* = £52 10*s.* — £48 19*s.* 0¼*d.* = £3 10*s.* 11¼*d.* gain.

20) For cost per ton divide £840 17*s.* 4½*d.* by 97. Now 11½*d.* × 97 × 20 = 19*s.* 2*d.* × 97 = £92 19*s.* 2*d.*

21) C = B + 270, and B = A + 100. ∴ C = A + 370. From £1520 take (370 + 100) and divide by 3 for A's share = 1050 ÷ 3 = £350; whence find the others.

23) Divide the quantity of iron ore by 451. (93) See No. 11 under Questions Worked out, *ante*.

24) Divide the first into the second. (95) See *Ex.* 5, page 53.

25) 365 days 5 hrs. 48 mins. 57 secs. = 31556937 secs., and 1 day = 86400 secs. Now (31556937 + 86400) × 25 = 791083425 secs. *Ans.*

26) *Use Table IX.* (98) See 13 in Questions Worked out.

(99) The largest tax will be on £199.

(100) In three years he will use nine white hats, cost £2 0*s.* 6*d.*, and four black ones, cost £2 2*s.* ∴ He will save 1*s.* 6*d.* by using the white or cheaper hats.

(101) Just divide by 13. (102) This is simple multiplication.

(103) We have merely to multiply the number of francs by $9\frac{1}{2}d.$ and the dollars by 4*s.* 6*d.* and add the results.

(104) See *Ex.* 5, page 34. (105) See *Ex.* 14, page 66.

(106) $Ans. = \frac{795 \times 7s.\ 9\frac{1}{2}d.}{18s.\ 9\frac{1}{4}d.} = \frac{\overset{15}{\cancel{795}} \times \overset{22}{\cancel{374}}}{\underset{53}{\cancel{901}}} = 330.$ [The learner will perceive that we used for "Contraction" the divisors 17 and 53. Find value of silk in ordinary way.]

(107) See *Ex.* 10, page 58.

(108) $Ans. = \frac{\overset{15}{\cancel{240}} \times \overset{3}{\cancel{42s.}}}{\underset{14}{\cancel{224}}} = 45s. = £2\ 5s.$

(109) 10 acres 1 rood 20 perches × 4 + 8 acres 3 roods 20 perches × 4 = 41 acres 2 roods + 35 acres 2 roods = 77 acres. Now £1 7*s.* 9*d.* × 77 = £106 16*s.* 9*d.* *Ans.*

(110) Use Table X., page 27.

(111) Divide by 35; then multiply the quotient by 3.

(112) $\frac{3}{4}$ sq. miles $= \frac{3}{\cancel{4}} \times \overset{160}{\cancel{640}}$ acres = 480 acres. Now reduce 480 acres 3 roods and 98 sq. yds. to sq. feet, by "Square Measure."

(113) A chain, or 100 links, being = 4 poles, 25 links = 1 pole, and 10 chains = 1 furlong, and 80 chains = a mile; hence the solution below:—

8,0)87567,9 chains, 25 links
10945 miles 79 chains, 25 links.

$\overset{4}{\cancel{4}}$,0)31,6 poles (+ 25 links = 1 pl.)
7 fur. (36 + 1) pls.

∴ *Ans.* = 10945 m. 7 f. 37 pls.

(114) A square chain, or 10000 square links = 16 poles ∴ 10 square chains, or 100000 sq. links = 160 pls. or 1 acre :—

Square chain.
1,0)765,8
765 ac. 8
4
10)32 rds.
3 rds. 2
40
10)80
8 pls.

10000)625 ac.
4
)2500 rds.
40
1000)1000 pls.

∴ *Ans.* = 765 acres 3 roods 9 poles.

(115) Cost of 17 gals. = 3*s.* 9*d.* × 17 = 63*s.* 9*d.*
Gain on 17 gals. = 1*s.* 6*d.* × 17

He sells

∴ 1 gal

(116) See *E.*

(117) Time sa

∴ *Ans.* = 4 yrs. 45 days 15 hrs. 45 m.

(118) Gain = 4*s.* 1½*d.* × 240 — 3*s.* 3¾*d.* × 256 = £49 10*s.* — £42 8*s.*
= £7 2*s.*, and cost = £42 8*s.*, as above.

(119) 78 lbs. 4 oz. = 78¼ lbs.

$$\therefore \textit{Ans.} = \frac{78\frac{1}{4} \times 7000}{5760} = \frac{313 \times 700}{4 \times 576} = \frac{54775}{576}$$

= 95 lbs. 1 oz. 2 dwts. 22 grs.

(120) Dividend paid = 6*s.* 8½*d.* + 4*s.* 3¾*d.* = 11*s.* 0¼*d.*
∴ Loss on every £ = £1 — 11*s.* 0¼ = 8*s.* 11¾*d.*
∴ *Ans.* = 2225 × 8*s.* 11¾*d.* = 445 × £2 4*s.* 10¾*d.*
= 89 × £11 4*s.* 5¾*d.* = £998 18*s.* 7¾*d.*

(121) Number of gals. at 10*s.* 6*d.* worth 80 gals. at 14*s.*

$$= \frac{80 \times 14}{10\frac{1}{2}} = \frac{80 \times 14 \times 2}{21} = \frac{320}{3} = 106\tfrac{2}{3}$$

$\therefore$ *Ans.* $= 106\frac{2}{3} - 80 = 26\frac{2}{3}$ gals.

(122) Wages of all in 6 days $= (1s.\ 4d. + 10d. + 4d.) \times 6 = 15s.$

$$\therefore \text{ Ans.} = \frac{£24\ 15s.}{15s.} = 33.$$

(123) Since contents = 8 times value of purse, £1 0*s.* 3*d.* = 9 times value of purse

$\therefore$ *Ans.* = £1 0*s.* 3*d.* $\div 9 = 2s.\ 3d.$

(124) See solution of (121) above.

(125) One-third of the children are infants = 200

$\therefore$ Boys and girls = 400

$\therefore$ Girls $= (400 - 18) \div 2 = 191$, and *Ans.* $= 191 + 18 = 209$.

(126) 20 for a shilling = 60 or 5 doz. for 3*s.* Now 60 sell for 4*s.* 2*d.*

$\therefore$ Gain on 60 = 1*s.* 2*d.*, and gain on 3000

$$= \frac{5 \quad 7}{60 \times 20 \times 12} = \frac{35}{12} = £2\ 18s.\ 4d.$$

(127) $\frac{87 \text{ qrs.}}{139} = 5$ bus. and 1 bus. remainder.

(128) Whole flock $= 72 + 92 = 164$. $\therefore$ One-half = 82

The shepherd who got 72 got 10 too little

$$\therefore \text{ Ans.} = \frac{£35}{10} = £3\ 10s.$$

(129) Number of posts in every mile $= \frac{1760}{88} = 20$.

Number passed in 3″ = 1 $\therefore$ in 60″ = 20, that is the number in 1 mile. $\therefore$ *Ans.* = 60 miles.

(130) See (119) above.

(131) *Ans.* $= (£1000 - £8\ 12s.\ 6d.) \div £12\ 17s.\ 6d. = 77$.

(132) Whole rent $350 \times 3s.\ 6d. + (38s.\ 9d. + 27s.\ 4d. + 17s.\ 4d. + 33s.\ 10d.) \times 100 = £61\ 5s. + £586\ 5s. = £647\ 10s.$

$$\therefore \text{ Ans.} = \frac{£647\ 10s.}{350} = \frac{£64\ 15s.}{35} = \frac{£12\ 19s.}{7} = £1\ 17s.$$

(133) 365 days 5 hrs. 48′ 57″ × 400 = 146096 days 22 hrs. 20′.
Again 365 × 303 + 366 × 97 = 110595 + 35502 = 146097 ds.
∴ *Ans.* = 146097 days − 146096 days 22 hrs. 20′ = 1 hr. 40′.

(134) Here (367 ac. 2 r. × 30½) ÷ 49 = (367 ac. 2 r. × 121) ÷ 196
= 44467 ac. 2 r. ÷ 196 = 226 ac. 3 r. 20 pls. *Ans.*

(135) From the whole weight take the weight of the truck and divide by 128.

(136) The Third + the First + the Second = the whole sum; that is the Third + twice the Third + 6 times the Third = 9 times the Third = £16 2*s.* 6*d.* ∴ The Third = £16 2*s.* 6*d.* ÷ 9 = £1 15*s.* 10*d.*, and so on.

(137) 47 days 7 hours = 477 hours' work.

$$\therefore \textit{Ans.} = \frac{477 \times \overset{10}{\cancel{120}} \times \overset{5}{\cancel{60}}}{\underset{12}{\cancel{144}}} = 23850.$$

(138) The price of 80 sheep + £13 3*s.* 9*d.* should be equal the price of 12 oxen.
∴ *Ans.* = (£1 17*s.* 6*d.* × 80 + £13 3*s.* 9*d.*) ÷ 12
= £163 3*s.* 9*d.* ÷ 12 = £13 11*s.* 11¾*d.*

(139) Cost of the soldiers for 9 days = 27 × £13 14*s.* + 140 × 36*s.*
∴ Cost for 1 day = 3 × £13 14*s.* + 140 × 4*s.* = £41 2*s.* + £28 = £69 2*s.*
∴ *Ans.* = £69 2*s.* ÷ 4146 = 4*d.*

(140) Here value of the various sums = 4988 × 9¾*d.* + 4988 × 4*s.* 2½*d.* + 2494 × 2*s.* 1½*d.* + 1247 × 2½*d.* = £202 12*s.* 9*d.* + £1049 11*s.* 2*d.* + £264 19*s.* 9*d.* + £12 19*s.* 9½*d.* = £1530 3*s.* 5½*d.* ∴ *Ans.* = £1530 3*s.* 5½*d.* − £1500 = = £30 3*s.* 5½*d.*

XV. Vulgar Fractions.

No difficulty can present itself in the solution of the fi questions under this head.

First Solution.

(13) $\frac{15}{16}$) $2\frac{1}{4}$ ($1\frac{7}{8}$

$\frac{6}{16}=\frac{3}{8}$) $\frac{15}{16}$ (2

$\frac{12}{16}$

$\frac{3}{16}$)$\frac{6}{16}$(2 ; $\therefore \frac{3}{16}$ is G. C. M. of $\frac{15}{16}$ and $2\frac{1}{4}$

Again $\frac{3}{16}$)4 (21 Again $\frac{1}{16}$)$5\frac{1}{3}$ (80

$3\frac{15}{16}$ 5

$\frac{1}{16}$)$\frac{3}{16}$(3 $\frac{1}{3}$ or $\frac{16}{48}$ (5

$\frac{15}{48}$

$\frac{1}{48}$)$\frac{3}{48}$ (3

$\frac{3}{48}$

$\therefore$ *Ans.* $\frac{1}{48}$

Second Solution.

$\frac{15}{16}$, $2\frac{1}{4}$, 4, $\frac{16}{3}=\frac{45}{48}$, $\frac{108}{48}$, $\frac{162}{48}$, $\frac{256}{48}$. Now G. C. numerators = 1, and of denominators = 48 ; $\therefore$ *Ans.* $=\frac{1}{48}$

(14), (15), (16). See Exs.

(17) $\frac{72}{168}=\frac{6}{14}=\frac{3}{7}$ (18) to (20) See (17).

$\frac{48}{160}=\frac{6}{20}=\frac{3}{10}$

$\frac{272}{1496}=\frac{34}{187}=\frac{2}{11}$

(21) Resolve into prime factors—

2)7040	2)7392
2)3520	2)3696
2)1760	2)1848
2)880	2)924
2)440	2)462
2)220	3)231
2)110	7)77
5)55	11
11	

Then, $\frac{7040}{7392}=\frac{\not2\times\not2\times\not2\times\not2\times\not2\times2\times2\times5\times\not{11}}{\not2\times\not2\times\not2\times\not2\times\not2\times3\times7\times\not{11}}=\frac{20}{21}$

finding the G. C. M. from the fractors, we have merely to ply the common factors together. Thus: $2 \times 2 \times 2 \times 2 = 352$, the G. C. M. of 7040 and 7392. See "Treatise," ndix I.

) and (23). See (21). (24) to (28). See Ex. 2.

) $\frac{17s.\ 6d.}{£1} = \frac{210}{240} = \frac{7}{8}$; $\frac{15s.\ 9d.}{20s.} = \frac{189}{240} = \frac{63}{80}$; $\frac{22\frac{1}{2}d.}{240} = \frac{45}{480}$

Ans.

(30) See (29), above.

(31) $\frac{9d.}{12d.} = \frac{3}{4} : \frac{7\frac{1}{2}d.}{12d.} = \frac{15}{24} = \frac{5}{8} : \frac{4\frac{1}{2}}{12} = \frac{9}{24} = \frac{3}{8}$ *Ans.*

(32) $\frac{2 \text{ qrs. } 14 \text{ lbs.}}{1 \text{ cwt.}} = \frac{70}{112} = \frac{5}{8}$, and so on.

(33) $\frac{2 \text{ r. } 20 \text{ p.}}{1 \text{ ac.}} = \frac{100}{160} = \frac{5}{8}$, and so on.

(34) $\frac{2s.\ 0\frac{3}{4}d.}{4s.\ 9\frac{3}{4}d.} = \frac{99}{231} = \frac{3}{7}$.

(35) $\frac{£2\ \ 6s.\ 8d.}{£3\ 13s.\ 4d.} = \frac{7}{11}$ (We multiply by $\frac{3}{3}$. for *Ans.*)

(36) $\frac{£23\ 11s.\ 4\frac{3}{4}d.}{£27\ 17s.\ 1\frac{1}{4}d.} = \frac{22627}{26741} = \frac{2057}{2431} = \frac{187}{221} = \frac{11}{13}$ *Ans.*

') In this Example we have merely to find the L. C. M. ɔ denominators, when all are reduced to improper fractions.

XVI.

), (2). See Ex. 1 (3) to (11). See Ex. 2.

2). See Ex. 3. (13) and (14) are easy.

(15). See Ex. 3.

(16) $$\frac{2}{13} \times 7\tfrac{1}{5} = \frac{2}{\not{13}} \times \frac{\overset{3}{\not{36}}}{5} = \frac{6}{5} = 1\tfrac{1}{5}$$

then $1\frac{1}{3}+\frac{2}{5}+\frac{3}{7}+\frac{1}{11} = 1+\frac{77+154+165+140}{5\times7\times11} = 1+\frac{536}{385}$

(17) to (32). See Ex. 3, &c. $[=2\frac{151}{385}$ *Ans.*

XVII.

No Question coming under this head differs materially fi the Examples given. In (18) and (19) the fractions in ( ) n first be added together.

XVIII.

(1) to (3) inclusive are similar to the Examples.
(4) $2\frac{3}{4} \times 5\frac{20}{21} = \frac{11}{4} \times \frac{125}{21} = \frac{1375}{84} = 16\frac{31}{84}$ *Ans.*
(5) to (18) inclusive. See (4), above.

(19) $$\frac{\overset{7}{\not{5}} \times 21 \times \not{12}}{\not{36}\ \not{3}} = 35d. = 2s.11d.$$

(20) $\frac{2}{3}$ of £ $= \frac{2\times20}{3} = \frac{40s.}{3} =$ £ 0 s. 13 d. 4

$\frac{\overset{3}{\not{7}}}{\not{7}}$ of £$\not{2}$ $\not{1}$0s. $\not{2}$d. $= 1\ 1\ 6$

$$2\tfrac{1}{3} \times 16s. = \frac{7\times16}{3} = \tfrac{112}{3} = 1\ 17\ 4$$

£3 12 2

(21) $$\frac{\overset{4}{\not{4}} \times \not{20} \times \not{12}d}{\not{15}\ \not{3}} = 64d. = 5s.\ 4d.$$

$3\frac{3}{13} \times 12a. = 3\ 2\frac{10}{13}$

(22) See (4), above. *Ans.* 8*s.* 7*d.*

XIX.

1) to (3). See Examples.

4) £7 12*s.* 6*d.* $\times \frac{12}{11} = \frac{£91\ 10s.}{11} = £8\ 6s.\ 4\frac{4}{11}d.$ *Ans.*

5) to (7) See (4), above.

(8) $\frac{\frac{3}{4}+\frac{1}{3}}{\frac{3}{4}} = \frac{5}{\cancel{4}} \times \frac{\cancel{4}}{3} = 1\frac{2}{3}$; $\frac{\frac{3}{5}}{\frac{4}{7}} \div \frac{4}{7} = \frac{3}{5} \times \frac{7}{4} \times \frac{1}{4} = \frac{21}{80}$

$$\frac{\frac{1}{2}+\frac{1}{4}}{\frac{1}{3}\times\frac{1}{4}} \div \frac{2}{3} = \frac{3}{\cancel{4}} \times \frac{3}{2} \times \frac{\overset{3}{\cancel{12}}}{1} = \frac{27}{2} = 13\tfrac{1}{2}$$

(9) See (8), above.

(10) *Ans.* $= \frac{7 \times \overset{5}{\cancel{20}}}{\underset{2}{\cancel{8}} \times \underset{10}{\cancel{50}}} = \frac{7}{20}$

(11) *Ans.* $= \frac{\overset{3}{\cancel{3}} \times \cancel{12}}{\cancel{4} \times 10} = \frac{9}{10}$

(12) *Ans.* $= \frac{\cancel{4}}{7 \times \underset{7}{\cancel{28}} \times 2} = \frac{1}{98}$

(13) to (26) inclusive. See Examples.

(27) *Ans.* $= \frac{2 \times 80}{9 \times 30} = \frac{16}{27}$ (28) to (30), See Examples 1, 2.

(31) and (32). See XVIII. (20).

XX. to XXIII.

All questions under these heads are fully as simple as th Examples given.

XXIV.

(1) ·25)3·24
or $\cancel{25})\cancel{32}\cancel{4}$
$\cancel{5}$ $\cancel{64}\cdot\cancel{8}$
1 12·96 *Ans.*

(2) $\cdot\cancel{32})\cancel{2}\cdot\cancel{50}$
$\cancel{4}$ $\cancel{31}\cdot\cancel{25}$
1 7·8125 *Ans.*

(3) to (5). See Examples.

(6) 6,0)47,6·532 tons.
7·9422
20
18·8440 cwt.
4
3·376 qrs.
7
2·632
4
7t. 18c. 3q. 10·528 lbs. *Ans.*

(7)
£
5·48)880·7648
1·37)220·191075
137
831 (160·5234
822 20
991 14·4680
959 12
320 5·616
274
467 (£160 14*s.* 5½*d.*
411
565
548

(8) 8) 1542800
8) 192850
24106·25 *Ans.*

(9) See Examples.

(10) *Ans.* $= \frac{\cdot0045}{\cdot03} = \frac{45}{300} = \frac{3}{20} = \cdot15$. (11) and (12) See Example

(13) to (23). See Examples.

(24) $\frac{0125}{10000} = \frac{25}{2000} = \frac{5}{400} = \frac{1}{80}$. (25) to (27). See (24).

(28) and (29). See Ex., p. 100.

The only questions that need be referred to are :—

(36) *Ans.* $= \frac{5 \times 63}{7 \times 240 \times 2} = \frac{9}{48 \times 2} = \frac{3}{32} = \cdot09375$

(37) *Ans.* $= \frac{4 \times 90}{9 \times 680} = \frac{1}{17}$

(38) *Ans.* $= \frac{5}{8 \times 8} = \frac{\cdot625}{8} = \cdot078125$; and $\frac{3}{14} = \frac{1\cdot5}{7} = \cdot2\dot{1}4285\dot{7}$

39) Second *Ans.* $= \frac{11}{2} \times \frac{1}{1760 \times 36} = \frac{1}{160 \times 72} = \frac{\cdot 1}{4 \times 4 \times 8 \times 9} =$
$\frac{\cdot 025}{\times 8 \times 9} = \frac{\cdot 00625}{8 \times 9} = \frac{\cdot 00078125}{9} = \cdot 000086805$

The other questions are much simpler.

XXV.

(1) and (2). See Exs.

(3) $\cdot 2\dot{7} = \frac{25}{90} = \frac{5}{18}$; $\cdot 5\dot{3}\dot{0} = \frac{585}{990} = \frac{117}{198} = \frac{13}{22}$

(4) $\cdot 58\frac{1}{3} = \frac{175}{300} = \frac{7}{12}$; $= \frac{692307}{999999} = \frac{62937}{90909} = \frac{6993}{10101} = \frac{2331}{3367} = \frac{333}{481}$
$= \frac{9}{13}$ *Ans.* (5) $\cdot 7\frac{1}{3} = \frac{22}{30} = \frac{11}{15} =$; $\cdot 8\frac{1}{3} = \frac{25}{30} = \frac{5}{6}$

(6) $\frac{18}{99} = \frac{2}{11}$; $\frac{7125}{9000} = \frac{1425}{1800} = \frac{285}{360} = \frac{19}{24}$

(7) $\cdot 4\frac{189}{999} = \cdot 4\frac{7}{37} = \frac{155}{370} = \frac{31}{74}$; $\cdot 8571\dot{4}\dot{2} = \frac{6}{7}$; hence we have
$\cdot 07\frac{6}{7} = \frac{55}{700} = \frac{11}{140}$ *Ans.*

(8) $\frac{819}{999} = \frac{91}{111}$; $\cdot \dot{7}69230 = \frac{10}{13}$; $\therefore$ *Ans.* $\cdot 05\frac{10}{13} = \frac{75}{1300} = \frac{15}{260} = \frac{3}{52}$

(9) $\cdot 0021 \times 48\cdot 026 = \frac{\overset{7}{21}}{\underset{3330}{9990}} \times 48\frac{\overset{8}{24}}{\underset{300}{900}} = \frac{7}{3330} \times \frac{14408}{300} = \frac{100856}{999000}$
$= \cdot 100956$; $\frac{297}{9990} \times \frac{666}{990} = \frac{297}{9990} \times \frac{666}{990} = \frac{\overset{1}{33}}{\underset{10}{1110}} \times \frac{\overset{2}{222}}{\underset{10}{330}} = \cdot 02$

COMPLEX FRACTIONS.

XXV (*a*).

(1) $\frac{17}{12}\times\frac{21}{10}\div\left(\frac{1}{2}+\frac{5}{24}\right)=\frac{\cancel{17}}{\cancel{12}}\times\frac{21}{\cancel{10}}\times\frac{\overset{2}{\cancel{24}}}{\cancel{17}}=4\frac{1}{5}.$

(2) Twenty and a hundredth=20·01

(3) $Ans.=\frac{4\frac{2}{3}+9\frac{1}{15}-(10\frac{4}{5}+\frac{4}{9})}{240}=(13\frac{1}{15}-11\frac{11}{45})\div 240$

$=\frac{112}{45\times 240}=\frac{7}{675}$

(4) $9\frac{43}{300}\times 11\frac{2}{33}\times £3\ 15s.\ 7\frac{1}{2}d.+7\frac{1}{3}\times 3s.\ 4\frac{1}{2}d.\div\frac{13}{2997}$

$=\frac{2743}{\cancel{300}}\times\frac{\overset{73}{\cancel{365}}}{\cancel{33}}\times £3\ \cancel{15}s.\ 7\frac{1}{2}d.+\frac{22}{\cancel{3}}\times\frac{\overset{999}{\cancel{2997}}}{13}\times 3s.\ 4\frac{1}{2}d.$

$=£\frac{11}{96}\times\frac{2743}{60}\times 73+\frac{27}{\cancel{100}}\times\frac{\overset{11}{\cancel{22}}}{\cancel{2}}\times\frac{999}{13}=\frac{2202629}{96\times 60}$

$+\frac{296703}{80\times 13}=\frac{49996793}{74880}=Ans.\ £667\ 13s.\ 10\frac{41}{312}d.$

Second Ans. $=\frac{39\cdot 371\times 100}{176\times 36}=\frac{246\cdot 06875}{11\times 36}=\cdot 621385732.$

(5) $Ans.=34\frac{1}{6}\div\left(\frac{\overset{18}{\cancel{180}}}{\cancel{10}}\times\frac{\overset{9}{\cancel{171}}}{\overset{5}{\cancel{55}}}\right)+\frac{\overset{4}{\cancel{08}}}{13}\times\frac{36}{\cancel{17}}-1\frac{9}{10}=\frac{205}{6}\times\frac{5}{162}$

$+11\frac{1}{13}-1\frac{9}{10}=\frac{1025}{972}+10\frac{1}{13}-\frac{9}{10}=10\frac{146}{631}\frac{23}{80}.$

(6) $(184\frac{53}{165}\times 4\frac{13}{25}\frac{3}{0}-825\cdot 558703)\div 322\cdot 906=(835\cdot 343733$
$-825\cdot 558703)\div 322\cdot 906=9\cdot 785033\div 322\cdot 906=\cdot 03.$

(7) $\left(2\frac{3}{4}+\frac{5}{2}\times\frac{7\times 5}{19}-\frac{\cancel{5}}{3}\times\frac{2}{\cancel{5}}\right)\div\frac{305}{228}=\left(2\frac{3}{4}+\frac{175}{38}-\frac{2}{3}\right)\times\frac{228}{305}$

$=\left(2\frac{1}{12}+4\frac{23}{38}\right)\times\frac{228}{305}=\frac{1525}{228}\times\frac{228}{305}=5\ Ans.$

(8) *Ans.* $= \frac{1\frac{1}{3}}{\frac{1}{4}\times\frac{12}{35}} \times \frac{9}{140} = \frac{4\times\cancel{4}\times\cancel{35}\times\overset{3}{\cancel{9}}}{3\times\cancel{12}\times\cancel{140}} = 1.$

The solution of second part is similar.

(9) *Ans.* $= \frac{1+\frac{2\times5}{19}}{\frac{9}{19}} \div 1 + \frac{4}{9\times7\frac{1}{2}} = \frac{29}{\cancel{19}} \times \frac{\cancel{19}}{9} \times 1\frac{8}{33}$

$$= \frac{29}{\overset{3}{\cancel{9}}} \times \frac{\overset{11}{\cancel{33}}}{41} = \frac{319}{123} = 2{\cdot}59349.$$

(10) *Ans.* $= \frac{3\frac{1}{2}\times1\frac{1}{3}}{2\frac{1}{6}\times3\frac{3}{50}} + \frac{\frac{15}{7}\times\frac{6}{7}}{3\frac{18}{99}\frac{19}{00}} \times \frac{\frac{64}{9}\times\frac{29}{14}}{\frac{16}{37}-\frac{19}{111}}$

$$= \frac{\frac{7}{2}\times\frac{4}{3}}{\frac{13}{6}\times\frac{153}{50}} + \frac{\frac{15}{7}\times\frac{6}{7}}{3\frac{151}{99}\frac{19}{00}} \times \frac{64}{9} \times \frac{\cancel{29}}{14} \times \frac{111}{\cancel{29}}$$

$$= \frac{14}{3}\times\frac{6}{13}\times\frac{50}{153} + \frac{15}{7}\times\frac{6}{7}\times\frac{9900}{31519}\times\frac{64}{9}\times\frac{111}{14}$$

$$= \frac{1400}{13\times153} + \frac{\overset{10}{\cancel{90}}\times9900\times\overset{32}{\cancel{64}}\times111}{7\times7\times31519\times\cancel{9}\times\underset{7}{\cancel{14}}}$$

$$= \frac{15135423800+699427872000}{21503112813} = \frac{714563295800}{21503112813}$$

$$= 33\tfrac{4960571297}{21503112813}.$$

(11) $\frac{\frac{9}{13}+\frac{5}{7}}{\cdot3\frac{4}{7}+\cdot3\frac{6}{13}} \times \frac{29}{740} + \frac{60}{73} \div \cdot1\frac{35}{73}$

$$= \frac{\cancel{128}}{\cancel{91}} \times \frac{\overset{2}{\cancel{18}}}{\cancel{128}} \times \frac{29}{\underset{370}{\cancel{740}}} + 5\tfrac{5}{9} = 5\tfrac{2111}{3330} = 5{\cdot}6\dot{3}\dot{9}. \quad \textit{Ans.}$$

(12) *Ans.* $= \frac{5}{\cancel{8}} \times \frac{\cancel{8}}{\underset{2}{\cancel{10}}} + \frac{7}{\cancel{12}} \times \frac{\overset{5}{\cancel{45}}}{\underset{7}{\cancel{21}}} - \frac{3}{4} = \frac{1}{2} + 1\tfrac{1}{4} - \tfrac{3}{4} = 1.$ Again

$$Ans. = 6\tfrac{1}{2} + \tfrac{5}{8} \div \left(\frac{\overset{3}{\cancel{39}}}{\underset{4}{8}} \times \frac{\cancel{2}}{\cancel{13}}\right) = 6\tfrac{1}{2} + \frac{5}{\underset{2}{\cancel{8}}} \times \frac{\overset{4}{\cancel{4}}}{\cancel{3}} = 6\tfrac{1}{2} + \frac{5}{6} = 7\tfrac{1}{3}.$$

$$(13)\ Ans. = \frac{3\frac{5}{6}}{\frac{5}{3}} \times \frac{275}{\underset{7}{\cancel{49}} \times \underset{3}{\cancel{81}}} \times \frac{\overset{5}{\cancel{27}} \times \cancel{121}}{\underset{4}{\cancel{52}}} \times \frac{\cancel{7} \times \cancel{13}}{23 \times \cancel{13}\cancel{33}\cancel{1}}$$

$$= \frac{\cancel{23}}{\underset{2}{\cancel{6}}} \times \frac{\cancel{3}}{\cancel{5}} \times \frac{\overset{5}{\cancel{275}}}{7 \times 3} \times \frac{1}{4 \times \cancel{23} \times \cancel{11}} = \frac{5}{168}.$$

$$(14)\ Ans. = \frac{\cancel{2}}{\cancel{5}} \times \frac{\overset{11}{\cancel{55}}}{\underset{3}{\cancel{6}}}\ £. + \frac{1\frac{1}{36}}{\frac{37}{36}} \times \frac{19}{20}\ \text{of}\ 5s. + 200d. \times \frac{125}{3}$$

$$= £3\ 13s.\ 4d. + \frac{\cancel{37}}{\cancel{24}} \times \frac{\cancel{36}}{\cancel{37}} \times \frac{19}{20} \times 5s. + £34\ 14s.\ 5\tfrac{1}{3}d.$$

$$= £38\ 12s.\ 6\tfrac{1}{3}d.$$

$$(15)\ Ans. = \frac{284\frac{53}{165}}{\underset{33}{106}} \times \frac{19000}{1200} + \frac{572\frac{1}{37} \times \frac{37}{6}}{\frac{2}{7} \times 1\frac{23}{43}\cancel{1}} \times \frac{17}{15}$$

$$= \frac{46913}{\underset{5}{\cancel{165}}} \times \frac{\cancel{33}}{106} \times \frac{199}{12} + \frac{\overset{1411}{\cancel{2111}\cancel{65}}}{\cancel{37}} \times \frac{\cancel{37}}{6} \times \frac{7}{2} \times \frac{49}{1231} \times \frac{17}{\cancel{15}}$$

$$= \frac{9335687}{6360} + \frac{8227541}{14772} = \frac{190233929124}{93949920} = 2024\tfrac{66975870}{78291600}.$$

$$(16)\ Ans. = \left(\frac{1}{\cancel{2}} \times \frac{\overset{5}{\cancel{55}}}{\cancel{17}} \times \frac{\overset{2}{\overset{4}{\cancel{68}}}}{\cancel{11}} - \frac{32}{\underset{3}{\cancel{9}}} \times \frac{\cancel{3}}{5}\right) \div \frac{12\frac{1}{24}}{3\frac{11}{12}}$$

$$= (10 - 2\tfrac{2}{15}) \div \frac{289}{\underset{2}{\cancel{24}}} \times \frac{\cancel{12}}{47} = \frac{118}{15} \times \frac{94}{289} = 2\tfrac{8}{43}\tfrac{8}{3}\tfrac{8}{5}.$$

17) *Ans.* $= \left(\frac{\frac{1}{12}}{\frac{7}{12}} + \frac{\frac{1}{20}}{\frac{9}{20}}\right) - \left(\frac{\frac{1}{24}}{\frac{7}{24}} - \frac{\frac{1}{40}}{\frac{9}{40}}\right) = \left(\frac{1}{12} \times \frac{12}{7} + \frac{1}{20} \times \frac{20}{9}\right)$
$- \left(\frac{1}{24} \times \frac{24}{7} - \frac{1}{40} \times \frac{40}{9}\right) = \frac{16}{63} - \frac{2}{63} = \frac{2}{9}.$

18) Here $\frac{1}{30} \times \frac{60}{57} \times \frac{3}{1} \times \frac{19}{2} = 1$; and $\frac{15}{18} - \frac{4}{15} = \frac{17}{30}$.

Now $1\frac{17}{30} \div 93\frac{3}{8} = \frac{47}{\cancel{30}_{15}} \times \frac{\overset{4}{\cancel{8}}}{747} = \frac{188}{11205}$ *Ans.*

19) $\frac{3}{11} + \frac{\frac{\overset{2}{\cancel{4}}}{\cancel{5}} \times \frac{\cancel{5}}{\cancel{2}} + \frac{5}{9}}{\frac{4}{5} + \frac{\cancel{5}}{2} \times \frac{9}{\cancel{5}}} + \frac{7}{\cancel{16}} \times \frac{\overset{2}{\cancel{32}}}{7} = \frac{3}{11} + 2 + 2\frac{5}{9} \div 5\frac{3}{16}$
$= 2\frac{3}{11} + \frac{23}{9} \times \frac{10}{53} = 2\frac{3}{11} + \frac{230}{477} = 2\frac{3962}{5247}$. *Ans.*

20) *Ans.* $= \frac{1\frac{19}{21}}{7\frac{5}{21}} \div \frac{7\frac{5}{21}}{1\frac{19}{21}} + \frac{\overset{8}{\cancel{152}}}{27} \times \frac{1}{\underset{3}{\cancel{57}}} = \frac{\overset{5}{\cancel{40}}}{\cancel{21}} \times \frac{\cancel{21}}{\underset{19}{\cancel{152}}} \times \frac{\cancel{21}}{\underset{19}{\cancel{152}}}$
$\times \frac{\overset{5}{\cancel{40}}}{\cancel{21}} + \frac{8}{81} = \frac{25}{19 \times 19} + \frac{8}{81} = \frac{4913}{29241}$.

21) (*a*) *Ans.* $= \frac{\frac{40}{3} \times \frac{40}{3} \times \frac{40}{3} - 1}{\frac{40}{3} \times \frac{40}{3} - 1} = \frac{236910}{1767}$
$= \frac{63973}{\underset{3}{\cancel{27}}} \times \frac{\cancel{9}}{1591} = \frac{63973}{4773} = 13\frac{52}{129}$.

(*b*) *Ans.* $\frac{\frac{\cancel{47}}{\cancel{8}} \times \frac{\cancel{4}}{\cancel{47}} + 3}{\frac{\cancel{47}}{\cancel{8}} \times \frac{\cancel{4}}{\cancel{47}} - \frac{1}{\underset{3}{\cancel{3}}}} \times \frac{9}{\cancel{7}} \times \frac{\overset{3}{\cancel{21}}}{20}$ £ $= 3\frac{1}{2} \times \frac{6}{1} \times \frac{27}{20}$ £
$= \frac{7}{\cancel{2}} \times \frac{\overset{3}{\cancel{3}}}{\underset{2}{\cancel{6}}} \times \frac{27}{20}$ £ $= \frac{567}{20} =$ £28 7s.

XXVI. Miscellaneous Exercises.

(1) and (3). Reduce the circulators to vulgar fractions bef adding.

(2) and (4). Attend to the vincula.

(5). Exhibits no difficulty.

(6). Glancing at the denominator, we see it becomes Again, since $1{\cdot}75 \div 7 = {\cdot}25$, the numerator becon $\cdot 002 \times \cdot 25000 \div 5 = 10$.

(7). Question $= \frac{2}{5} \times \frac{\overset{4}{\cancel{20}}}{3} + £2\frac{1}{2} + \frac{2\frac{1}{4} - \frac{\cancel{2}}{3} \times \frac{11}{\cancel{6}}}{\frac{1}{5} \times \frac{10}{3} + \frac{13}{36}} \times \frac{19}{20} \times 5s.$

$= £5\frac{1}{6} + \frac{2\frac{1}{4} - 1\frac{2}{9}}{\frac{2}{3} + \frac{13}{36}} \times \frac{19}{20} \times \frac{5}{20} = £5\frac{1}{6} + \frac{\cancel{37}}{\cancel{36}} \times \frac{\cancel{36}}{\cancel{37}} \times \frac{19}{20} \times$

$= £5\frac{1}{6} + \frac{19}{80} = £5\ 8s.\ 1d.$

(8). Here the first decimal becomes 2·5, and the second · or $\frac{1}{100}$.

(9). Is simple.

(10).—$(1\frac{7}{10} + 3\frac{9}{16} + 2\frac{1}{20} + \frac{5}{24})$

$= 10 - \left(6 + \frac{168 + 135 + 12 + 50}{240}\right) = 4 - \frac{\overset{73}{\cancel{365}}}{\underset{48}{\cancel{240}}} = 4 - 1\frac{25}{48} = 2$

Again $15\frac{1}{15} - 7\frac{25}{48} = 8\frac{33}{80}$ *Ans.*

(11). $\frac{3{\cdot}45 \times 10\frac{1}{2}}{2\frac{1}{2}} = \frac{\overset{69}{\cancel{3}{\cdot}45} \times 21}{\cancel{5}} = 14{\cdot}49$, which we multiply 120 for final *Ans.*

(12) and (13). See Exs.

Here £970 4s. = $\frac{2}{5}$ of the sum he had before the last in-
nt; ∴ the whole sum = £2425 10s., which in turn was
hat he had before the stockjobbing. Now dividing by 7
t $\frac{1}{8}$ = £346 10s.; and hence $\frac{8}{8}$ or the whole = £2772,
was $\frac{4}{5}$ of his original capital; and so on.

and (16) are easy.

. Since 23205 = 4641 × 5 = 17 × 7 × 3 × 13 × 5. Now since
f these factors but 13 will measure the denominator, 13
G. C. M.

(19) and (20) are elementary.

). The proof by vulgar fractions is

$$37\frac{2812}{10000} \div \frac{407}{100000}$$

$$\therefore \frac{93203}{2500} \times \frac{40}{407} = 9162\frac{186}{407}$$

$$= 9162{\cdot}45702 \text{ as before.}$$

).

		s	d.
£$\frac{5}{12}$ - - -	=	8	4
$\frac{3}{7}$ of a guinea	=	9	0
$\frac{4}{13}$ of a shilling	=	0	$3\frac{9}{13}$
$\frac{8}{13}$ of a halfpenny	=	0	$0\frac{4}{13}$
		17	8 *Ans.*

. *Here the decimals* are respectively equal to the vulgar
ns $\frac{3}{4}$, $\frac{1}{20}$, $\frac{7}{99}$, and $\frac{67}{495}$, and the work is then easy.

(24), (25) are as simple as the Examples.

(26) Expressing *Ans.* in pence, we have

$$\frac{\cancel{30} \times \cancel{3}}{\frac{4 \times \cancel{240}}{8}} = \frac{3}{32} = \cdot 09375.$$

(27) and (28) are Elementary.

(29) See (10), above.

(30) See (22), above.

(31) Divide $15\frac{3}{5}$ by $\frac{2}{5}$.

(32) See (22), above.

(33) Here $\cdot\dot{2}1\dot{6}$ of $8s.\ 5\frac{3}{4}d. = 22d.$

and $\cdot\dot{7}$ of £9 $5s.\ 7\frac{1}{2}d. = 1732{\cdot}5$

$$\therefore Ans. = \frac{220}{17325} = \frac{4}{63} = \cdot 0\dot{1}26984\dot{}$$

(34) is very easy.

(35) On resolving the denominator into factors, we find $= 8 \times 8 \times 241.$

$$\therefore Ans. = \frac{\cancel{241}}{8 \times 8 \times \cancel{241}} = \frac{\cdot 1}{8 \times 8} = \frac{\cdot 125}{8} = \cdot 015625$$

(36) $$Ans. = \frac{\cancel{7} \times 30}{\frac{8 \times \cancel{252}}{36}} = \frac{5}{8 \times 6} = \frac{\cdot 625}{6} = \cdot 10416\dot{}$$

(37) $$Ans. = \cdot 18\frac{17}{11\cancel{0}} = \frac{2005}{11100} = \frac{401}{2220}$$

(38) and (39) are very simple.

XXVI.

40) $Ans. = \dfrac{\frac{8}{17} \times 3 \times 1760 \times 3 \times 12\text{in.}}{5\text{ m. }5\text{ f. }7\text{ pls.}} = \dfrac{8 \times 3 \times 1760 \times 3 \times 12 \times 17}{11\frac{11}{17}\text{ in.}} = \dfrac{6082560 \times 17}{552960} = \dfrac{345600}{2880} = 360 = 4 = \frac{1}{4}$

Again $\dfrac{275}{1000} - \dfrac{248}{900} = \dfrac{5}{90000}$ and $\dfrac{276}{1000} - \dfrac{248}{900} = \dfrac{4}{90000}$;

$\therefore$ ·276 is nearer by $\dfrac{1}{10000} = \cdot 0000\dot{1}$

41) See several similar questions previously worked.

42) See (40) above.

43) $Ans. = £366\frac{1}{3} \times \cdot 525 + \dfrac{27}{999} \times £2\ 18s.\ 7d.$

$= \dfrac{525 \times 1099}{3 \times 1000} + \dfrac{1}{37} \times £2\ 18s.\ 7d. = £192\ 6s.\ 6d. + 1s.\ 7d.$

$= £192\ 8s.\ 1d.$

44) Expressing each in days, we have

$Ans. = \left(\dfrac{12 \cdot 57}{24} + \cdot 42 + \cdot 3 \times 7\right) \div 365\frac{1}{4} = 3 \cdot 04375 \div 365 \cdot 25$

$= \cdot 0083\dot{3}.$

45) $1\frac{2}{3} = \frac{3}{7} \times 5s.\ 10d. = 2s.\ 6d.$; $\therefore Ans. = 2s.\ 6d. \div 1\frac{2}{3} = 1s.\ 6d.$

46) $\dfrac{12 \cdot 55}{\cdot 01004} + \dfrac{1255}{10 \cdot 04} + \dfrac{\cdot 001255}{1004} = 1250 + 125 + \cdot 00000125$

$= 1375 \cdot 00000125.$

47), (48), (49) exhibit no difficulty.

50) 640 acres = 1 *square* mile.

XXVII. Practice.

(1) to (4). See Exs.

(6)

		3107		
$10s. = \frac{1}{2}$ of £1		1553	10	
$4s. = \frac{1}{5}$,,		621	8	
$6d. = \frac{1}{8}$ of $4s.$		77	13	6
$1\frac{1}{2}d. = \frac{1}{4}$ of $6d.$		19	8	$4\frac{1}{2}d.$
	£5378	$19s.$	$10\frac{1}{2}d.$	*Ans.*

(7) and (8). See (6), above.

(9)

		4562		
		3		
		13686		
$15s. = \frac{1}{4}$ of £3		3421	10	
$9d. = \frac{1}{20}$ of $15s.$		171	1	6
$\frac{1}{2}d. = \frac{1}{18}$ of 9d.		9	10	1
$\frac{1}{4}d.$ of £3 $15s.$ $9\frac{1}{2}d.$		0	18	$11\frac{3}{8}$
	£17289	$0s.$	$6\frac{3}{8}d.$	

(10) to (15). See (6), above. (16) See (9), above.

(17) to (26). See (6), above. (27) See Ex. 12.

(28) See Ex. 8.

(29)

	oz.	dwts.	grs.			
	11	6	15			
	3	3	$1\frac{1}{2}$			
	33	19	$10\frac{1}{2}$	price at £3	per oz.	
$15s. = \frac{1}{4}$ of £3	8	9	$11\frac{5}{8}$	,,	$15s.$	,,
$2s.\ 6d. = \frac{1}{6}$ of $15s.$	1	8	$3\frac{15}{16}$	,,	$2s.\ 6d.$	,,
$3d. = \frac{1}{10}$ of $2s.\ 6d.$	0	2	$9\frac{15}{160}$	,,	$3d.$	,,
$1d. = \frac{1}{3}$ of $3d.$	0	0	$11\frac{53}{160}$	,,	$1d.$	,,
	£44	$1s.$	$11\frac{3}{80}d.$	*Ans.*		

(30) to (34). See Ex. 8. (34) See Ex. 9.

(35)

tons.	cwts.	lbs.
8	13	18
20		
173		
4		
692 qrs.	18 lbs.	

3*d.* = $\frac{1}{4}$ of 1*s.*	173		
$\frac{1}{2}$*d.* = $\frac{1}{6}$ of 3*d.*	28	10	
14 lbs. = $\frac{1}{2}$ of a qr.		$1\frac{3}{4}$	
4 lbs. = $\frac{1}{7}$ „		$\frac{1}{2}$	
2,0)	20,2	$0\frac{1}{4}$*d. Ans.*	
	£10	2*s.* $0\frac{1}{4}$*d. Ans.*	

and (37). See Ex. 7, in Practice.

(38)

cwts.	qrs.	lbs.	
1	1	8	105 = 7 × 5 × 3
		7	
9	1	0	
	5		
46	1		
	3		
138	3		weight of the 105 pockets.
1	5		
138	15		price at £1 per cwt.
	4		

	555	0		„	£4 „
10*s.* = $\frac{1}{2}$ of £1	69	7	6	„	10*s.* „
2*s.* 6*d.* = $\frac{1}{4}$ of 10*s.*	17	6	$10\frac{1}{2}$	„	2*s.* 6*d.* „
	£641	14*s.*	$4\frac{1}{2}$*d. Ans.*		

to (41). See Ex. 10.

(42) and (43). See Ex. 12.

	£80	13	4
2 rds. = $\frac{1}{2}$ of 1 ac.	40	6	8
10 pls. = $\frac{1}{8}$ of 2 rds.	5	0	10
5 pls. = $\frac{1}{2}$ of 10 pls.	2	10	5
4 pls. = $\frac{1}{20}$ of 2 rds.	2	0	4
11 yds. = $\frac{1}{11}$ of 4 pls.	0	3	8
1 yd. = $\frac{1}{11}$ of 11 yds.	0	0	4
	£50	2*s.*	3*d.*

(45) and (46). See Exs. 16 and 17. (47) See Ex. 15.

(48) 26 ft. 4 in.
18 8
45 × 2 = circuit of room.

$$\therefore \frac{45 \times 2 \times 12\frac{1}{4}}{9 \times \frac{7}{8}} = \frac{\overset{5}{\cancel{45}} \times 2 \times \overset{7}{\cancel{49}} \times \overset{2}{\cancel{8}}}{\underset{1}{\cancel{9}} \times \underset{1}{\cancel{4}} \times \underset{1}{\cancel{7}}} = 140$$

(49) See Ex. 6.

(50) 16
11
27 × 2 = circuit of room.

$$\therefore \frac{\overset{9}{\cancel{27}} \times \overset{2}{\cancel{2}} \times \overset{5}{\cancel{10}} \times 7\frac{1}{2}}{(2\frac{1}{2} \times \overset{3}{\cancel{3}}) \times \underset{2}{\cancel{20}} \times \underset{4}{\cancel{12}}} d. = £2\ 5s.$$

(51) See Ex. 15.

XXVIII. Miscellaneous Exercises.

(1) to (7). See Exs. 6 and 7.

(9)

	£25	8	4		
			9		
	228	15	0	cost of 9 miles.	
4 fur. = ½ of 1 mile.	12	14	2	„ 4 furlongs	
1 „ = ¼ of 4 fur.	3	3	6½	„ 1 furlong	
8 pls. or 44 yds. = ⅕ of 1 „	0	12	8½	„ 44 yards.	
	£244	5s.	5d.		

(10) See (29). (11) See (38).

(12) to (28) Same as Exs.

9) $\frac{\cancel{12}\,3}{28}$ of $\frac{1}{4} = \frac{3}{20}$

85960

$1d. = \frac{1}{12}$ of $1s.$ | 7163 4

$\frac{2}{20} = \frac{1}{10}$ of $1d.$ | 716 4

$\frac{1}{20} = \frac{1}{2}$ of $\frac{2}{20}$ | 358 2

2,0)823,7 10.

£411 17*s.* 10*d. Ans.*

(20) and (21). See (9), (22) to (24) See Ex. 16.

(25) See Ex. 7. (26) See (29).

(27) See (50). (28) See Ex. 10.

(29)

£1 0 0

14 $9\frac{1}{2}$

5*s.* $2\frac{1}{2}d.$

£1384 16

$5s. = \frac{1}{4}$ of £1 | 346 4 0

$2\frac{1}{2}d. = \frac{1}{24}$ of $5s.$ | 14 8 6

£360 12*s.* 6*d.*

(30) See note to *Answer*. (31) See Ex. 7.

(32) £3 18 8

6

23 12 0

2 bus. $= \frac{1}{4}$ of 1 qr. | 19 8

1 „ $= \frac{1}{2}$ of 2 bus. | 9 10

1 pk. $= \frac{1}{4}$ of 1 „ | 2 $5\frac{1}{5}$

$\frac{1}{2}$ „ $= \frac{1}{2}$ of 1 pk. | 1 $2\frac{3}{4}$

$\frac{1}{4}$ „ $= \frac{1}{2}$ of $\frac{1}{2}$ „ | $7\frac{3}{8}$

£25 5*s.* $9\frac{5}{8}d.$ *Ans.*

(33) to (40) Same as Examples. (41 See (9), Above.

(42) *to (49). Same as* Examples.

(50)

yds.	qrs.	nls.
329	3	2
4		
1319 qrs.		2
1		5
1319	·	10 cost at £1 per q

$5s. = \frac{1}{4}$ of £1 | 329 17 6 „ 5s. „
$2\frac{1}{2}d. = \frac{1}{24}$ of 5s. | 13 14 $10\frac{3}{4}$

£343 12s. $4\frac{3}{4}d.$ *Ans.*

(51) and (52). See (6), above (53) See Ex. 9.

(54)

£365

$10s. = \frac{1}{2}$ of £ | 182 10s.
$2\frac{1}{2}d. = \frac{1}{48}$ of 10s. | 3 16s. $0\frac{1}{2}d.$

£178 13s $11\frac{1}{2}d.$

Now £200 − £178 13s. $11\frac{1}{2}d.$ = £21 6s. $0\frac{1}{2}d.$

(55) No. of gross $= \frac{5899}{12 \times 12} = 40$ and 139 articles.

£	s.	d.	
4	12	9	
		8	
37	2	0	
		5	
185	10	0	cost of 40 gross.
4	12	9	„ 1 „
190	2	9	
0	2	$6\frac{11}{12}$	
0	0	$7\frac{35}{48}$	
0	3	$2\frac{31}{48}$	cost of 5 articles.
189	19	$6\frac{17}{48}$	*Ans.*

4 articles $= \frac{1}{36}$ of a gross
1 „ $= \frac{1}{4}$ of 4 „

(56) See (55).

(57)

(457 = 56 × 8 + 9)

£14·889583 × 457
= £6804·539583
= £6804 10s. $9\frac{1}{2}d.$

14	17s.	$9\frac{1}{2}d.$	(9)
		8	
119	2	4	
		8	
952	18	8	
		7	
6670	10	8	
134	0	$1\frac{1}{2}$	
6804	10	$9\frac{1}{2}$	*Ans.*

E.—In multiplying $14{\cdot}889583$ by 457 just reject the cir-
g figure $\cdot\dot{3}$ and add $\frac{1}{3}$ of 457 to the product. Proceed in
ar manner in multiplying by 20 and 12 respectively for
llings and pence of answer.

$$\cdot 3\dot{2}\dot{7} = \cdot 3\tfrac{3}{11} = \tfrac{18}{55}$$
$$\cdot 70\dot{3} = \tfrac{703}{999} = \tfrac{19}{27}$$
$$\cdot 24 = \tfrac{24}{100} = \tfrac{6}{25}$$

	c.	qr.	lbs.	oz.		c.	qr.	lbs.	oz.
$\frac{18}{55}$ of	1	2	0	7	=	0	1	27	2
$\frac{19}{27}$ of	9	1	3	8	=	6	2	3	8
$\frac{6}{25}$ of	7	2	10	$12\frac{1}{2}$	=	1	3	8	3
						8	3	10	13

8 cwt. 3 qrs. 10 lbs. 13 oz. at £8 13*s.* 4*d.* per cwt.
10*s.* $1\frac{1}{14}$*d.* *Ans.*

XXVIII (*a*).

Exs. 2 and 3. (2) See Ex. 2.

s. $= 17 \times 17 \times 17 = 4813$ c. in. $= 2$ c. ft. 1457 inches.

Ex. 2. (5) 36 ft. 9 in.) 101 yds. 3 ft. 90 in.

12 — 9

441 — 912

12

10944

12

441) 131418

42) 14602

7) 2806

298 in. = 24 ft. 10 in. *Ans.*

9·37 (7) See Ex. 1.

2 39·37 39·37 39·37

8·74 one edge; $\therefore \frac{39{\cdot}37 \times 39{\cdot}37 \times 39{\cdot}37}{27 \times 1728}$

864

432

$= \frac{6102337{\cdot}7953}{11664} = 282$ c. ft. 891·023624 in.

(8)

	2 ft.	7′	11″			
	3	5′	7″			
	7	11	9			
	1	1	3	7‴		
		1	6	7	5⁗	
Sq. ft.	9	2′	7″	2‴	5⁗	

The first figure 9 is square fe the second 2′ is = 2 twelfi of a square foot, that is, rectangle a foot long and in. broad = 24 sq. in.; 7″ = 7 sq. in.; 2‴ is = $\frac{2}{12}$ or of a sq. in. and 5⁗ is = $\frac{1}{1}$ of a square inch.

(9) See Ex. 2.

(10) It is evident area ÷ width = length, ∴ $144 \div 6\frac{3}{4}$
$= 144 \times 4 \div 27 = 16 \times 4 \div 3 = 21\frac{1}{3}$ in. = 1 ft. $9\frac{1}{3}$ in. *An*

(11) *Ans.* $= \frac{1 \text{ c. y, } 6 \text{ ft. } 1296 \text{ in.}}{2 \text{ y.} \times 1\frac{1}{2} \text{ y,}} = \frac{\cancel{9}\cancel{0}}{\cancel{5}\cancel{4}\cancel{0}} \frac{\cancel{4}\cancel{8}\cancel{0}\cancel{0}}{\cancel{5}\cancel{8}\cancel{3}\cancel{2}\cancel{0} \text{ in.}} = 15$ inches.
$\cancel{7}\cancel{2} \times \cancel{5}\cancel{4}$
$\cancel{6} \quad \cancel{6}$

(12) Area of top and bottom $= 30 \times 15\frac{1}{2} \times 2$
„ two sides $= 30 \times 11 \times 2$
„ two ends $= 13\frac{1}{2} \times 11 \times 2$

$\therefore Ans. = \frac{930 + 660 + 297}{144} = 13\frac{5}{48}$ sq. feet.

(13) Solidity in yards

$$= \frac{128000000 \times \overset{40}{\cancel{160}} \times 121 \times \cancel{9} \times 115}{\cancel{27} \quad \cancel{4}}$$
$$3$$

$= 71244800000000 \div 3 = 23748266666666$ c. yds. 18 ft.

(14) $\frac{\overset{3}{\cancel{12}} \times 4\frac{1}{6} \times \cancel{9}\frac{1}{3} \times 2\frac{1}{2}}{8\frac{1}{3} \times 6\frac{2}{3}} = 7\frac{1}{2}$ ft. *Ans.*
$\cancel{2} \quad \cancel{2}$

XXIX. Simple Proportion.

Questions (1) to (42) inclusive are as simple as the Exampl worked under the rule.

(43) 5 cwts. 2 qrs. 20 lbs. = 636 lbs.
ratio of 2*s.* 6*d.* to 2*s.* = 30 : 24 = 5 : 4

$$\therefore \text{First man's share} = \frac{\overset{53}{\cancel{636}} \times 7\frac{1}{2} \times \overset{1}{\cancel{5}}}{\underset{3}{\cancel{9}} \times \underset{4}{\cancel{12}} \times \underset{4}{\cancel{20}}} = \frac{53 \times 5}{3 \times 4 \times 2} = \frac{265}{3 \times 8}$$

$$= \frac{£88\ 6s.\ 8d.}{8} = £11\ 0s.\ 10d. \quad \text{Share of second} = \frac{\overset{53}{\cancel{212}} \times 7\frac{1}{2} \times 4}{\underset{3}{\cancel{9}} \times \underset{8}{\cancel{12}} \times \underset{2}{\cancel{20}}}$$

$$= \tfrac{53}{6} = £8\ 16s.\ 8d.$$

44) Work done in $10 \times 10\frac{1}{2} \times 9 = 945$ hours
the three men work $3 \times 6 \times 10 = 180$ hours.
$\therefore$ the others must work $\frac{945 - 180}{7 \times 10} = \frac{765}{70} = 10\frac{13}{14}$ hrs. a day.

45) 48 : 12 :: 144 : 36 *Ans.*

Compound Proportion.

1) See Examples.

2) 7 men : 30 men
12 days : 11 days
$8\frac{1}{4}$ hrs. : $7\frac{4}{5}$ hrs.
} 34 ac : no. of acres required.

$$\therefore \text{no. of acres} = \frac{\overset{2}{\cancel{30}} \times 11 \times 34 \times \overset{13}{\cancel{39}} \times \overset{1}{\cancel{4}}}{7 \times \underset{4}{\cancel{12}} \times \underset{5}{\cancel{33}} \times \underset{5}{\cancel{5}}} = \tfrac{884}{7} = 126\tfrac{2}{7}$$

(3) to (10). Same as Examples.

(11) 90 : 200
10 : 8
} 12 days.
(160 × 6 × 4) : (450 × 4 × 3)

$$\therefore \textit{Ans.} = \frac{\overset{5}{\cancel{200}} \times \overset{2}{\cancel{8}} \times \overset{1}{\cancel{450}} \times \overset{1}{\cancel{4}} \times \overset{1}{\cancel{3}} \times \overset{1}{\cancel{12}}}{\underset{2}{\cancel{90}} \times \underset{1}{\cancel{10}} \times \underset{1}{\cancel{160}} \times \underset{1}{\cancel{6}} \times \underset{1}{\cancel{4}}} = 30 \text{ days}$$

(12) See (2), above.

XXXI. Miscellaneous Exercises.

(1) to (4). See Exs. in Simple Proportion.

(5) to (9) are very easy.

(9) $\frac{3}{4}$ m. : 1000 yds. : : 120 : *Ans.*
30 : 36
21 ft. : 22 ft.

(10) From 1st May to 31st October = 184 days, and 365 — 1
= 181

$$\therefore \text{cost} = (184 + {}^{1}\tfrac{8}{2}{}^{1}) \times 800 \times 1\tfrac{1}{5} \times 6\tfrac{5}{6}d. = £7198$$

(11) Required sum $= \dfrac{\cancel{£}\ 19 \quad 4\frac{1}{2} \quad 42\frac{3}{4}}{7 \times \cancel{£} \times \cancel{9s.} \times \cancel{1}3\frac{1}{2}} = \dfrac{\cancel{£}5\frac{1}{2}}{\cancel{£}} \times 7 = £299\ 5s.$
$\cancel{£0} \times \cancel{1}2$
$\cancel{5} \quad \cancel{4}$
2

(12) $Ans. = \dfrac{9 \times 11 \times 2}{6} = 33$

(13) Since 1 man = 2 boys, 16 boys = 8 men.

(14) to (17). See Exs.

(17) 20 : 21 : : $44\frac{1}{2}$: = $46\frac{2}{40}$ *Ans.*

(18) £4726$\frac{1}{2}$: £1 : : 1181$\frac{5}{8}$: 5*s.* *Ans.*

(19) An ordinary Proportion.

(20) Cost by navvies $= \dfrac{20 \times 42 \times 15}{24} = £52\ 10s.$

„ workmen $= \dfrac{28 \times 20 \times 30}{24} = £70$

hence navvies the cheaper. For second *Ans.* say
$52\frac{1}{2}$: 70 : : £3000

(21) See Exs.

(22) (22 × 18) : (27 × 16) : : £18 5*s.* 9*d.* : £18 18*s.* *Ans.*

23) See XXVII., Ex. 18.

24) $\frac{5s.\ 6d. + 4s.\ 6d.}{2} = 5s.$ average cost.

$$\text{Required cost} = \frac{35\cancel{00} \times \cancel{5}}{\cancel{100} \times \cancel{20}}\cancel{£} = £8\ 15s.$$
$$4$$

25) £1 : £125 10*s.* : : 23*fr.* 6 *cen.* : *Ans.*

$\therefore$ *Ans.* $= 125{\cdot}5 \times 23{\cdot}06 = 2894$ *fr.* 30 *centimes.*

(26) to (35) are similar to Examples in Treatise.

(36) $\left.\begin{matrix} 221 : 437 \\ 57 : 119 \\ 1 : 2 \end{matrix}\right\}$: : 780 men : required number.

$$\therefore \textit{Ans.} = \frac{\overset{23}{\cancel{437}} \times \overset{7}{\cancel{119}} \times \overset{20}{\cancel{780}} \times 2}{\underset{17}{\cancel{221}} \times \underset{19}{\cancel{57}}} = 6440$$

(37) $93\frac{1}{2} : 89\frac{1}{4} : : 76\frac{1}{2}$: required price

$$\therefore \text{ Required price} = \frac{\overset{21}{\cancel{357}} \times 153 \times \cancel{2}}{4 \times \cancel{2} \times \underset{11}{\cancel{187}}} = {}^{3}\tfrac{21}{44}{}^{3} = 73\tfrac{1}{44}$$

(38) Number of yards $= 27\frac{1}{3} \times 10\frac{\overset{3}{\cancel{75}}}{\underset{36}{\cancel{900}}} \div (7\frac{1}{3} \times 3)$

$$= \frac{\overset{41}{\cancel{82}} \times \overset{11}{\cancel{33}} \times \cancel{3}}{\cancel{3} \times 36 \times \underset{\cancel{2}}{\cancel{22}} \times \cancel{3}} = \tfrac{451}{36} = 12{\cdot}527 \textit{ Ans.}$$

(39) See note in Treatise.

(40) The ratios of 80, 100, 60, and 20 are the same as and 1.

$$\begin{array}{r} 4\times 14d. = 56d. \\ 5\times 20 \ =100 \\ 3\times 58 \ =174 \\ 1\times 34 \ = \ 34 \\ \hline 13 \text{ lbs.} \ =364 \end{array}$$

$$\therefore \text{ Required value} = \frac{364\times 3}{13\times 16}\,d. = \frac{21}{4} = 5\tfrac{1}{4}d.$$

(41) Is very easy. (42) $Ans. = \frac{£257\ 2s.}{85\frac{14}{20}} =$

(43) to (49) are as simple as many Examples already wor

(50) 3 bus. : 12 qrs. 2 bus. 1 pk. : : 16*s.* 9*d.* : *Ans.*

4	8		12
12	98	£10	1 0
4	4		11
	392	110	11 0
	131		16 9
		4)109	14 3
		£27	8*s.* $6\frac{3}{4}d.$ *Ans.*

(51) See (16), above. (52) See (42), above.

(53) See Ex. 8, p. 119. (54) and (55) See Exampl

(56) £1078 : £78 10*s.* : : £370 18*s.* $5\frac{1}{2}d.$

20	20			12	
2156	1570	4451	1	6	
				12	
		53412	18	0	prod. by 144
		4451	1	6	„ 12
		370	18	$5\frac{1}{2}$	„ 1
	2156)	58234	17	$11\frac{1}{2}$	„ .
		£27	0*s.*	$2\frac{2}{4}\frac{3}{3}\frac{6}{12}\frac{7}{2}d.$	

7) and (58). See Ex. 3 in Arithmetic.

9) 90 pioneers : : 16 pioneers
42 days : 5 days : : $12\frac{1}{2}$ hours
$(139\frac{3}{4} \times 4\frac{1}{2} \times 2\frac{1}{2}) : (4910\frac{1}{16} \times 4\frac{7}{8} \times 3\frac{1}{5})$

$$= \frac{16 \times 5 \times 7 \times 8561 \times 39 \times 16 \times 25 \times 4 \times 2 \times 2}{90 \times 42 \times 559 \times 16 \times 8 \times 5 \times 2 \times 9 \times 5} = 12\tfrac{8}{9} \text{ Ans.}$$

(30) 24 n. : 138 n.
9 hrs. : 11 hrs.
$(232\frac{1}{2} \times 3\frac{2}{3} \times 2\frac{1}{3}) : (337\frac{1}{2} \times 5\frac{3}{5} \times 3\frac{1}{2})$: : $5\frac{1}{2}$ days.
7 : 4

$$= \frac{248 \times 11 \times 675 \times 22 \times 7 \times 11 \times 2 \times 3 \times 3 \times 4}{24 \times 9 \times 2 \times 5 \times 2 \times 2 \times 495 \times 11 \times 7 \times 7} = 132 \text{ men } \textit{Ans.}$$

XXXII.

) This question is as simple as the Examples.

2) (1.) *Ans.* = 3600 th.
4 th. = 3 sc.
4 sc. = 1 Nap.
15 Nap. = £11 15*s.*

Then $\frac{3600 \times 3 \times 235s.}{4 \times 4 \times 15} = 10575s.$

1.) Worth of thalers = $3600 \times 3s. = 10800s.$
Loss = $225s. = £11\ 5s.$ *Ans.*

(3) See (2), above.

(4) *Ans.* = 128 sixth
sixth 14 = 15 fifth
fifth 10 = 9 fourth
fourth 8 = 7 third
third 6 = 5 second
second 2 = 3 first

$$= \frac{\overset{\not 1\not 0}{\not 1\not 2\not 8} \times \overset{5}{\not 1\not 5} \times 9 \times \overset{\not 7}{\not 1} \times \overset{\not 8}{\not 1} \times 3}{\underset{\not 2}{\not 1\not 4} \times \underset{\not 2}{\not 1\not 0} \times \underset{\not 2}{\not 8} \times \underset{\not 2}{\not 6} \times \not 2} =$$

(5) Direct remittance in francs $= 3508 \times 24{\cdot}6 = 86100$

Now for circuitous remittance.

Ans. = £3500
£1 = 55¼ lire
4¼ lr. = 1 merk
10 m. = 19 francs.

$$\text{Then } \frac{3500 \times 221 \times 9 \times 4}{10 \times 17 \times 4 \times 10} = 86450$$

$$\therefore \text{Gain} = 86450 - 86100 = 350 \text{ fr.} = \frac{350}{24{\cdot}6} = £14\ 4s.\ 6\tfrac{246}{41}d.$$

(6) *Ans.* = 20 s.
66 s. = 5760 grs. $\times \frac{1}{120}$
15·43235 gr. = 1 gram
461 $\times \frac{9}{10}$ gr. = 100 francs.

$$= \frac{5760 \times 111 \times 100 \times 10 \times 20 \times 10}{66 \times 15{\cdot}43235 \times 461 \times 9} = \frac{296000}{234772{\cdot}33955} = 25 [$$

(7) *Ans.* = 21 claret
14 claret = 18 sherry
12 sherry = 8 brandy
6 brandy = 10 malt.

$$= \frac{\overset{\not 2}{\not 2\not 1} \times \overset{3}{\not 1\not 8} \times \overset{4}{\not 8} \times 10}{\underset{\not 2}{\not 1\not 4} \times \underset{\not 2}{\not 1\not 2} \times \underset{\not 2}{\not 6}} = 30 \text{ gals.}$$

(8) and (9). See (7), above.

XXXIII. Partnership.

(1) to (3), See Examples under the Rule.

XXXIV. Simple Interest.

(1) Interest $= \frac{£507\frac{1}{2} \times 13 \times 4}{100 \times 4} = \frac{\overset{203}{\cancel{1014}} \times 13}{\underset{20}{\cancel{100} \times 2}} = {}^{2}\frac{6}{4}\frac{3}{0}{}^{9}$

$= £65\ 19s.\ 6d.$

(2) Interest $= \frac{£1257\frac{3}{4} \times 23 \times \cancel{4}}{100 \times 4} = \frac{\overset{50{\cdot}31}{\cancel{5031}} \times 23}{4 \times \cancel{100}} = \frac{1157{\cdot}13}{4}$

$= £289\ 5s.\ 7\frac{1}{5}d.$

(3) Interest $= \frac{£\cancel{3000} \times \cancel{4} \times 8}{\cancel{1200}} = £80$

Hence £80—(14*d.* × 80)=£80 − £4 13*s.* 4*d.*=£75 6*s.* 8*d. Ans.*

(4) to (7). See (1) and (2), above.

(8) From 3rd March to 18th December = 290 days.

Now interest $\times \frac{£194 \times \cancel{5} \times 29\cancel{0}}{\underset{730}{\cancel{50}\cancel{0}}} = \frac{7626}{730} = £7\ 14s.\ 1\frac{7}{73}d.$ *Ans.*

(9) and (10). See (1) and (2), above. (11) See (8), above.

(12) $\frac{£76\ 5s.\ 1\frac{1}{2}d.}{2} = £38\ 2s.\ 6\frac{3}{4}d.$ interest on £1270 18*s.* 9*d.*

for one year; ∴ Rate per cent.

= £1270 18*s.* 9*d.* : £100 : : £38 2*s.* $6\frac{3}{4}d.$: 3 *Ans.*

(13) to *(15). See (12)* above.

(16) Interest on £171 7*s.* 6*d.* = £217 1*s.* 6*d.* − £171 7*s.* 6*d.* = £45 14*s.*

$$\text{Required time} = \left.\begin{array}{l}\dfrac{\text{£45 14}s.}{\dfrac{\text{£171 7}s.\ 6 \times 3\frac{1}{3}}{100}}\end{array}\right\} = \frac{\text{£45 14}s. \times 100 \times 3}{\text{£171 7}s.\ 6d. \times 10} \quad \begin{array}{l}20\\ \text{£}\not{45}\ \not{14}s. \times \not{100} \times \not{3}\\ \text{£}\not{171}\ \not{7}s.\ \not{6}d. \times \not{10}\\ \text{£}\not{57}\ \not{2}s.\ \not{6}d.\\ \text{£}\not{11}\ \not{8}s.\ \not{6}d.\end{array}$$

= 8 years.

(17) See (16), above.

(18) $106\frac{1}{2}$: £45 0*s.* $9\frac{3}{4}d.$ :: 100 : required sum.

$$\therefore \text{Required sum} = \frac{\text{£45 0}s.\ 9\frac{3}{4}d. \times 100 \times 2}{213}$$

= £42 5*s.* 10*d.*

(19), (22), and (25), See (18), above.

(20), (21), (27), and (29), See (12), above.

(23) See (8), above.

(24), 26), (28), and (30), See (1), above.

XXXV. Discount.

(1) Interest on £100 from 15th March till 28th July at 5 per cent $= \frac{\not{100} \times \not{5} + \not{135}}{\not{365}\not{00}} = 1\frac{35}{73}$ £

Now £$100\frac{135}{73}$: £$743\frac{1}{2}$ :: $1\frac{35}{73}$: discount required.

$$\therefore \text{Discount required} = \frac{\not{73} \times \not{148}\not{7} \times \not{135}}{\not{74}\not{35} \times \not{73} \times 2} \quad \begin{array}{l}27\\ \not{5}\end{array} = \text{£13 10}s.$$

And £743 10*s.* − £13 10*s.* = £730 the present worth.

(2) See (1), above.

(3) 208 : 18*s.* :: 1000 : required price

$$\therefore \text{Required price} = \frac{100 \times 1\not{8}}{\not{10}\not{8}} \quad \begin{array}{l}\\ 6\end{array} = 16s.\ 8d.$$

(4) to (10). See (1), above.

(11) Since discount on £105 at 5 per cent. = £5
5 : 15 :: £105 : £315 *Ans.*

(12) Number paid for $= \frac{£20\ 8}{24s.} = \frac{\overset{51}{\not{4}\not{0}\not{8}}}{\underset{3}{\not{2}\not{4}}} = 17$

$\therefore 25 - 17 = 8$ allowed on scale of 25
$\therefore$ *Ans.* 25 : 100 :: 8 : 32

(13) It is evident 365 days elapsed from the first purchase until the payment; $\therefore$ *Ans.* $= \frac{365+1}{2} = 183$

Again, interest of any sum, say £100 for 183 days at 5 per cent. $= \frac{\not{1}\not{0}\not{0} \times 183 \times \not{5}}{\underset{73}{3\not{6}\not{5}\not{0}\not{0}}} = \frac{183}{73}$; $\therefore 100\frac{183}{73} : 100 = 7483 : 7300$

XXXVI. Commission.

(1) to (6). See Examples in Arithmetic.

(7)

		£234,0			
£2½ = $\frac{1}{40}$ of £100	58	10		premium at £2 10*s.* p.c.	
6*d.* = $\frac{1}{100}$ of £2½	0	11	$8\frac{2}{5}$	„	6*d.* „
	£57	18*s.*	$3\frac{3}{5}$ *Ans.*		

(6) See note in Arithmetic p. 166

(9) 95 : 1805 :: 100 : £1900 *Ans.*

(10) and (11). See (7), above.

XXXVII. Equation of Payments.

(1) £100 due "one year hence" = £105 due 2 years hence.

Again £500 due 3 years hence = 105 : 100 :: £500 : £467$\frac{1}{7}$ due 2 years hence; $\therefore$ *Ans.* = £105 + £467$\frac{1}{7}$ = £518$\frac{1}{7}$

(2), (3), and (5). See Ex. 2

(4) $\frac{1}{2} \times 2 = 1$
$\frac{1}{3} \times 4 = 1\frac{1}{3}$
$\frac{1}{6} \times 12 = 2$
$4\frac{1}{3}$ *Ans.*

XXXVIII. The Stocks.

(1) Amount of stock $= \frac{\cancel{£}\cancel{0}\cancel{8}\cancel{0}\cancel{2} \times \cancel{1}\cancel{0}\cancel{0}}{\cancel{7}\cancel{6}\ \cancel{1}\cancel{9}} = £8950$

(2) and (3). See (1) above.

(4) Number of shares $= \frac{£14701\frac{1}{2}}{148\frac{1}{2}} = \frac{29403}{297} = 99$

(5) Number of shares $= \frac{£4600}{28\frac{5}{8} + \frac{1}{8}} = 160$

(6) Amount required $= \frac{18\cancel{5}\cancel{0} \times 87\frac{1}{8}}{\cancel{1}\cancel{0}\cancel{0}} = £1611\ 16s.\ 3d$

(7) and (8). See (6) above.

(9) Amount required $= \frac{£4770 \times 35\frac{3}{8}}{10} = £16873\ 17s.\ 6d.$

(10) Amount required $= \frac{£6850 \times 76\frac{1}{4}}{100} = £5223\ 2s.\ 6d.$

(11) Income required $= \frac{£2560\ 8s.\ 9d. \times 3}{72\frac{1}{8}} = £106\ 10s.$

(12) to (14). See (11), above.

(15) Income required $= \frac{£1128\ 8s.\ 9d. \times 2\frac{1}{2}}{(28\frac{5}{8} + \frac{1}{8})} = £98\ 2s.\ 6d.$

(16) to (18). *See* **Ex.** (5), above.

) Required rate $= \frac{10 \times 12}{30} = 4$ (20) See Ex. 1.

.) First income $= \frac{29{\cdot}54}{\cancel{£2}\cancel{9}\cancel{5}\cancel{4} \times 4}{\cancel{1}\cancel{0}\cancel{0}} = £88{\cdot}62$

Then $\left.\begin{matrix} 3: & 4 \\ 98: & 80\frac{1}{2} \end{matrix}\right\}$: : £88·62 : second income.

$$\therefore \text{Second income} = \frac{\overset{4{\cdot}22}{\cancel{2}} \quad \overset{}{\cancel{2}\cancel{9}{\cdot}\cancel{5}\cancel{4}} \quad \overset{23}{}}{\underset{\cancel{3}}{\cancel{4}} \times \cancel{8}\cancel{8}{\cdot}\cancel{6}\cancel{2} \times \underset{\cancel{1}\cancel{9}}{\cancel{1}\cancel{6}\cancel{1}}} = 97{\cdot}06$$

$\therefore$ Increase = £97·06 — £88·62 = 8·44 = £8 8*s.* 9$\frac{3}{5}$*d.*

2) See Ex. 1, in Arithmetic.

3) Average selling price $= (94\frac{7}{8} + 95\frac{5}{8}) \div 2 = 95\frac{1}{4}$

$\therefore$ Loss $= (96 - 95\frac{1}{4}) \times 100 = £75$ *Ans.*

4) $\left.\begin{matrix} 3: & 5 \\ 100: & 96 \end{matrix}\right\}$: : 100 or first income : second income.

$$\therefore \text{Second income} = \frac{\overset{32}{}}{\underset{\cancel{3}}{5} \times \cancel{9}\cancel{6} \times \cancel{1}\cancel{0}\cancel{0}} = £160$$

$\therefore$ Increase per cent. $= 160 - 100 = 60$ *Ans.*

5) First income $= \frac{£75\cancel{0}\cancel{0} \times 6}{\cancel{1}\cancel{0}\cancel{0}} = £450$

$\therefore \left.\begin{matrix} 96: & 120 \\ 6: & 3 \end{matrix}\right\}$: : 226 : income from one half

$$= \frac{\overset{5}{\cancel{1}\cancel{2}\cancel{0}} \times \cancel{3} \times 225}{\underset{8}{\cancel{9}\cancel{6}} \times \cancel{6}} = £140 \ 12s. \ 6d.$$

Again; $\left.\begin{matrix}90:120\\6:\ 5\frac{1}{2}\end{matrix}\right\}$:£225:income from second half

$$= \frac{120 \times 11 \times 225}{90 \times 2 \times 6} = £275$$

$\therefore$ £450—£415 12*s.* 6*d.* = £34 7*s.* 6*d.* decrease

(26) See (21), above.

(27) First income $= \frac{£9075 \times 3}{90\frac{3}{4}} = £300$

$\therefore \left.\begin{matrix}3 & : & 3\frac{1}{4}\\ 93\frac{1}{2} & : & 91\end{matrix}\right\}$ ::£300:second income.

$$\therefore \text{second income} = \frac{\overset{100}{\cancel{13}} \times \cancel{300} \times 91 \times \cancel{2}}{\cancel{4} \times 187 \times \cancel{3}} = £316\ 6s.\ 2\tfrac{82}{187}d.$$

$\therefore$ Increase = £316 6*s.* $2\frac{82}{187}$*d.* − £300 = £16 6*s.* $2\frac{82}{187}$*d.*

(28) $\left.\begin{matrix}£3\frac{1}{2}:£932\\ 233d.:240d.\end{matrix}\right\}$ ::£91:sum required.

$$\therefore \text{Sum required} = \frac{\overset{4}{\cancel{932}} \times \cancel{91} \times 240 \times 2}{\cancel{7} \times \cancel{233}} = £24960$$

(29) See (29), above.

(30) First income $\frac{6000 \times 3}{100} = £180$

$$\left.\begin{matrix}2 & : & 5\frac{1}{2}\\ 103\frac{1}{8} & : & 92\frac{1}{4}\end{matrix}\right\} :: 180 : \text{second income}$$

$$\therefore \text{Second income} = \frac{\overset{12}{\cancel{30}} \quad 123 \quad \cancel{2}}{\cancel{11} \times \cancel{180} \times \cancel{369} \times \cancel{8}} = £295\ 4s.$$

$$\cancel{2} \times \cancel{4} \times \cancel{3} \times \cancel{825}$$

$$\cancel{165}$$

$$\cancel{5}$$

$\therefore$ Increase = £295 4*s.*—£180 = £115 4*s.*

(31) First income $= \frac{£8000 \times 3}{100}$

$\therefore$ Second income

$$= \frac{8000 \times 3 \times 5 \times 92\frac{7}{8}}{100 \times 3 \times 102} = \frac{80 \times 5 \times 743}{102 \times 8} = £364\ 4s.\ 3\tfrac{13}{17}d.;$$ hence

') Sum gained on £100 stock by the sale $= 92\frac{7}{8} - 92\frac{1}{8} = \frac{3}{4}$.
Add half-yearly dividend and $2\frac{1}{4}$ = gain on $92\frac{1}{8}$ in six months. Now $92\frac{1}{8} : 100 :: 4\frac{1}{2} : 4\frac{8}{73}\frac{2}{7}$ *Ans.*

) State as 4*s.* 9*d.* : 2*s* 9*d.* :: 5 : $2\frac{17}{19}$

) First income $= \frac{£3400 \times 3}{86\frac{1}{4}} = \frac{3400 \times 3 \times 4}{345} = £118\frac{6}{23}$

Second income $= \frac{£1700 \times 4}{97} + \frac{£1700 \times 3\frac{1}{2}}{94} = \frac{6800}{97} + \frac{11900}{188}$

$= £70\frac{10}{97} + £63\frac{14}{47}$

$\therefore$ *Ans.* $= £70\frac{10}{97} + £63\frac{14}{47} - £118\frac{6}{23}$

$$133 + \frac{10810 + 31234 - 29354}{97 \times 47 \times 23} - 118 = 15\frac{14690}{104857}$$

$= £15\ 2s.\ 9\frac{6531909}{1048577}d.$

') Sums paid $= £100 + £25 + £37\ 10s. = £162\ 10s.$
Interest on Sums (paid $= £100 \times 18 + £25 \times 5) \times \frac{5}{1200}$
$= (1925 \times \not{5}) \div \not{1200} = £8\ 0s.\ 5d.$

$\therefore$ *Ans.* $= £162\ 10s. + £8\ 0s.\ 5d. = £170\ 10s.\ 5d.$

') The saving on every £100 $= \frac{1}{2}$

$\therefore$ Total saving $= \frac{£8000000}{100} \times \frac{1}{2} = £40{,}000.$

The diminution on every £100 $= 101 - 95\frac{5}{8} = 5\frac{5}{8}$.

$\therefore$ Total diminution $= \frac{£8000000}{100} \times 5\frac{5}{8} = £450{,}000$

Sum paid to Shareholders $= \frac{£2500000}{100} \times 6\frac{1}{2}$

Hence the statement

$$40 : 100 :: \frac{£2500000}{100} \times 6\frac{1}{2} = \frac{2500000 \times 13 \times \not{100}^{50} \times \not{240}^{6}}{\not{40} \times 236 \times \not{2}}$$

$236 : 240$

$\frac{9750000000}{236} = £413135\ 11s.\ 10\frac{2}{59}d.$

(38) Every £92½ will amount to £92½ + the dividends 3×21 = 155½.

$$\therefore Ans. = \frac{10000 \times 92\frac{1}{2}}{155\frac{1}{2}} = 5948\tfrac{17}{311}$$

(39) First income = £40ϕϕ × $\frac{85}{1ϕϕ}$ = £3400.

$$\text{Second income} = \frac{£4000 \times 25 \times 3}{97\frac{1}{2}} = \frac{£96000 \times 6}{195}$$

$$= \frac{£38400}{13} = £2953\ 16s.\ 11\tfrac{1}{13}d.$$

$\therefore Ans.$ = £3400 − £2953 16*s.* $11\frac{1}{13}d.$
= £446 3*s.* $0\frac{12}{13}d.$ decrease.

(40) Sum which will bring £200 a year in the 3 per cents. = £200 × 90 ÷ 3 = £6000. Now this sum represents 6000 × 100 ÷ 150 in the Water Works = £4000, but he had 500 × 10 = £5000 stock at first.

$\therefore Ans.$ = (£5000 − £4000) ÷ 10 = £100.

(41) $\frac{£32000 \times 100}{4}$ = 800000 = $\frac{4}{5}$ of the capital.

$\therefore$ Whole cap. = £800000 + (800000 ÷ 4) = £1000000.
5 per Cent. on $\frac{1}{5}$ cap. = (£200ϕϕ × 5) ÷ 1ϕϕ = 10000.
$\therefore$ £32000 + £10000 = £42000 the sum paid in dividends = 100 − (48 + 10) = 42 per cent. on receipts.
$\therefore Ans.$ = 42 : 100 :: £42000 : £100000.

(42) Interest of £1 in 3 per cent. = $\frac{3}{89\frac{5}{8}}$ Do. do. in railway shares = $\frac{5}{102\frac{5}{8}}$

$$\therefore Ans. = \frac{3}{89\frac{5}{8}} : \frac{5}{102\frac{5}{8}} = \frac{\overset{8}{\cancel{24}}}{\underset{239}{\cancel{717}}} : \frac{40}{821} = 6568 : 10360$$

$$= 821 : 1295$$

Again $\frac{149\frac{5}{8}}{7\frac{1}{2}} : \frac{180\frac{1}{2}}{9} = \frac{1197}{60} : \frac{361}{18} = 3591 : 3610 = 189 : 190$

XXXIX. Profit and Loss.

100 : 74*s.* : : 116 : required price

$$\therefore \text{Required price} = \frac{116 \times 74s.}{100} = £4\ 5s.\ 10\tfrac{2}{25}d.$$

115 : $\frac{£75}{200}$ (selling price per yard) : : 100 : prime cost

$$\therefore \text{Prime cost} = \frac{£75 \times 100}{115 \times 200} = 6s.\ 6\tfrac{6}{23}d.$$

£3 6*s.* 8*d.* per cwt. = $\frac{800}{112}d.$ per lb.

$$\therefore \tfrac{800}{112} : 110 : : 7\tfrac{1}{2} : Ans. + 100$$

$$\therefore Answer = \frac{\overset{3}{\cancel{110}} \times \overset{7}{\cancel{112}}}{\underset{1}{\cancel{80}} \times 2} - 100 = {}^{2}\tfrac{3}{2}{}^{1} - 100 = 15\tfrac{1}{2}$$

See (1), above.

Loss if sold for £80 = 100 + 12 − 80 = £32

$$\therefore \text{Entire loss} = \frac{60 \times 32}{80} = £24$$

$$\text{First cost} = \frac{60 \times 100}{80} = £75$$

90 : 118 : : 15*s.* : : required price

$$\therefore \text{Required price} = \frac{118 \times 15}{90} = 19s.\ 8d.$$

See Ex. 2, in Arithmetic. (8) See (2), above.

(9) $100 : 7\frac{1}{2}d. :: 6\frac{2}{3} :$ gain on each lb.

$$\therefore \text{Gain on each lb.} = \frac{20 \times 15}{3 \times 2 \times 100}$$

$$\therefore \textit{Ans.}, \text{ in lbs.} = \frac{£63\ 12s.\ 3d. \times 112}{\frac{1}{2}d.} = 274 \text{ cwt. } 2 \text{ qrs. } 14 \text{ lbs.}$$

$$\text{(10) Gain on each stone} = \frac{£14\ 11s.\ 8d.}{500} = \frac{3500d.}{500} = 7d.$$

$$= 12\frac{1}{2} \text{ per cent.} = \frac{1}{8}$$

$\therefore$ First cost $= 7d. \times 8 = 4s.\ 8d.$, and selling price $= 4s.\ 8d.$ $+ 4s.\ 8d. \div 8 = 5s.\ 3d.$

(11) See Ex. 2. (12) See (3), above.

(12*a*) Area of yard $= 1\frac{3}{4} \times 1$. Since 5 per cent. $= \frac{1}{20}$

$$\text{Area after shrinking} = 1\tfrac{3}{4} \times \tfrac{19}{20} \times \tfrac{19}{20}$$

Consequently we have the following statement:—

$$(1\tfrac{3}{4} \times \tfrac{19}{20} \times \tfrac{19}{20}) : \begin{matrix} 1 \\ 105 : 112 \end{matrix} \Big\} 15s. : 10s.\ 7\tfrac{2}{3}\tfrac{3}{6}\tfrac{3}{1}d.\ \textit{Ans.}$$

(13) 3 cwt. at $5d.$ per lb. $+ 7$ cwt. at $6\frac{1}{2}d.$ per lb. $= 336 \times 5d.$

$$+ 784 \times 6\tfrac{1}{2}d. = 6776d. = \text{prime cost of 10 cwt.}$$

$$5\tfrac{1}{2} \text{ cwt. at } 5\tfrac{1}{2}d. \text{ per lb.} = 3388d.$$

Therefore required price per lb.

$$= \left(6776d. - 3388d. + 6776d. \times \frac{\cancel{50}^{1}}{\cancel{100}_{2}} \right) \div 4\tfrac{1}{2} \times 112$$

$$= \cancel{6776} \div 504 = \cancel{4}\cancel{7} \div \cancel{6}\cancel{3} = 121 \div 9 = 13\tfrac{4}{9}d.$$

(14) See Ex. 2.

XI. AVERAGES AND PERCENTAGES.

1) See (3), p. 176, above. (2) See Ex. 1, above.

3) Required population $= 1256{\cdot}5 \times 6 - (1236+452+364+516+3530) = 7539 - 5998 = 1541$

4) Loss on £100 $= £100 - 91\frac{2}{3} = 8\frac{1}{3}$

$$\therefore £100 : \frac{£3484}{5} :: £8\tfrac{1}{3} : \text{required loss}$$

$$\therefore \text{Required loss} = \frac{3484 \times \cancel{2}\cancel{5}}{\cancel{5} \times 100 \times 3} = £58\ 1s.\ 4d.$$

5) See Ex. 4. (6) Required gain $= \frac{100 \times 14}{22} = 63\frac{7}{11}$

7), (8), (9), (10), See Examples. (11) See (13).

12) Required number $= \frac{84624 \times 100 \times 100}{86 \times 82} = 120000$

13) Population of both countries in 1841 = 28,786,000

$$\text{,,} \quad \text{,,} \quad \text{,,} \quad 1851 = \frac{21476000 \times 108{\cdot}45}{100}$$

$$+ \frac{7310000 \times 87{\cdot}5}{100} = 29686972$$

$\therefore$ 28,786,000 : 29,686,972 :: 100 : 100 + required increase

$$\therefore \text{Required increase} = \frac{29{,}686{,}972 \times 100}{28{,}786{,}000} - 100 = 3{\cdot}129896\ldots$$

14) See Examples 1 and 2.

15) Average in 1st class $= \frac{6186899}{4355{\cdot}5} = 1420{\cdot}479\ldots$

$$\text{,,} \quad \text{2nd} \quad \text{,,} \quad = \frac{18844152}{4355{\cdot}5} = 4326{\cdot}518\ldots$$

$$\text{,,} \quad \text{3rd} \quad \text{,,} \quad = \frac{24848312}{3455{\cdot}5} = 5705{\cdot}042\ldots$$

(16) Percentage of first class $= \dfrac{6186899 \times 100}{6186899+1884415\,2+2484831} = 12{\cdot}4.$

The percentages of second and third are found in the sam manner.

(17) *Ans.* $= \dfrac{25 \times 100}{35} = 71\frac{3}{7}$. (18) *Ans.* $= \dfrac{210{\cdot}5 \times 100}{21{\cdot}05} = 10($

XLI. Involution.

The Questions 1 to 6 are as simple as the Examples.

(7) $1\frac{1}{3} = \frac{4}{3}$: Now $\frac{4}{3} \times \frac{4}{3} \times \frac{4}{3} = \frac{64}{27} = 2{\cdot}\dot{3}7\dot{0}$ *Ans.*

$\cdot\dot{2}\dot{7} = \frac{27}{99} = \frac{3}{11}$; and $(\frac{3}{11})^4 = \frac{81}{14641}$; $1{\cdot}\dot{8}\dot{3} = 1\frac{5}{6} = \frac{11}{6}$;

and $\frac{11}{6} \times \frac{11}{6} \times \frac{11}{6} = \dfrac{1331}{6 \times 6 \times 6} = \dfrac{221{\cdot}8\dot{3}}{6 \times 6}$

$$= \frac{36{\cdot}97\dot{2}}{6} = 6{\cdot}120\dot{3}\dot{7}$$

(8) and (9) See (7) above.

(10) $\dfrac{7\frac{272}{900}}{\cdot 7\frac{675}{999}} = \dfrac{7\frac{108}{111}}{\cdot 7\frac{75}{111}} = \dfrac{7\frac{36}{37}}{\cdot 7\frac{25}{27}} = \dfrac{\frac{295}{37}}{\frac{284}{370}} = \dfrac{295}{\cancel{37}} \times \dfrac{\overset{10}{\cancel{370}}}{284} = \frac{2050}{284}$;

and $(\frac{2950}{284})^3 = \frac{25672375000}{22906304} = 1120\frac{216431}{2863288}$

XLII. Square Root.

(1) and (2). See Examples. (3) $\sqrt{262\frac{11}{25}} = \sqrt{6\frac{561}{25}} = \frac{81}{5}$ $= 16\frac{1}{5}$. In general it is better to reduce a mixed numbe to an improper fraction before extracting the root.

(4) to (6). See Examples.

(7) Second part.—Since $\cdot\dot{9} = 1$, we have $\sqrt{378{\cdot}3025} = 19{\cdot}45$

Second part— $\sqrt{42{\cdot}0336\dot{1}} = \sqrt{42{\cdot}0336\frac{1}{3}}$

$$= \sqrt{\frac{378{\cdot}3025}{9}} = \frac{19{\cdot}45}{3} = 6{\cdot}48\dot{3}.$$

Second part— $\cdot\dot{6}04938271\dot{1} = \frac{49}{81}$; hence the *Ans.*

XLIII. Cube Root.

to (3). See Examples in Treatise.

$\sqrt[3]{5164\frac{109}{343}} = \sqrt[3]{\frac{1771561}{343}} = 1\frac{21}{7} = 18\frac{2}{7}$ *Ans.*

to (10). See Examples.

) For the second *Ans.* multiply the first by $\sqrt[3]{\cdot 027} = \cdot 3$

) Surface in feet $= \sqrt[3]{(37 \times 1728 + 64)^2} \times 6 \div 144$

$$= 40 \times \not{40} \times \not{6} + \not{144} = \frac{200}{3}$$

$$\therefore \textit{Ans.} = \frac{200}{3} \times 1\tfrac{1}{3}s. = \frac{2600}{27} = £4\ 16s.\ 3\tfrac{5}{8}d.$$

) Since $\cdot\dot{9} = \frac{9}{9} = 1$ we have

$$\textit{Ans.} = \sqrt{\frac{16}{9}} + \sqrt[3]{\frac{1000}{27}} - 1 + \sqrt[3]{\cdot 125} + \frac{\sqrt{3}}{3\sqrt{3}}$$

$$= 1\tfrac{1}{3} + 3\tfrac{1}{3} + \cdot 5 + \tfrac{1}{3} - 1 = 5\tfrac{1}{2} - 1 = 4\tfrac{1}{2}. \quad (14)\ \text{See } (13).$$

XLIV. Progressions.

Questions in Progressions are now very seldom given unless ong the papers on Algebra; and, those in the Arithmetic, under above *head, being* as easy as the Examples, none are worked *here.*

XLV. Compound Interest.

(1), (2), (3). See Ex. 1. (4). See (5).

(5) Required amount $= £4800 \times 1{\cdot}03125^3$

$= 4800 \times 1{\cdot}090710205078125 = £5164\ 4s.\ 2\frac{3}{32}d.$

(6). See (5). (7), (8), (9), and (10). See Ex. 2.

(11) Required sum

$$= \frac{£405\ 3s.\ 4\frac{1}{2}d.}{1{\cdot}05^4} = \frac{£405{\cdot}16875}{1{\cdot}21550625} = £333{\cdot}\dot{3} = £333\ 6s.\ 8d.$$

(12) See (11) above. (13) Required interest.

$= £4000 \times 1{\cdot}01^5 - £4000 = £4204{\cdot}0402004 — £4000$

$= £204\ 0s.\ 9{\cdot}648096d.$ *Ans.*

(14) Compound interest on £1 for 4 years at 6 p. c.

$= 1 - (1{\cdot}06)^2 = {\cdot}26227696.$ Now since simple interest $= \frac{4 \times 6}{100} = {\cdot}24$

We have difference on £1 = ·26 &c.—·24 = ·02227696.

$\therefore$ *Ans.* = £945 16*s.* 8*d.* × ·02227696.

XLVI.

The only question requiring a remark is (29).

	miles.
	220
	11
	2420
2 f. = ¼ of a mile	55
1 f. = ½ of 2 fur.	27 10
20 pls. = ½ of 1 f.	13 15
5 yds. = $\frac{1}{22}$ of 20 pls.	0 12 6
	£2516 17 6 *Ans.*

XLVII.

Here we work only one question.

(39) Expressing both in shillings, $Ans. = \frac{3\frac{3}{4} \times 21}{2\frac{3}{4} \times 20} = \frac{\overset{3}{\cancel{15}} \times \cancel{4} \times 21}{\cancel{4} \times 11 \times \overset{\cancel{20}}{4}}$

$$= \frac{63}{11 \times 4} = \frac{15{\cdot}75}{11} = 1{\cdot}4318\dot{1}\dot{8}$$

XLVIII.

Here we work two questions; again referring those who wish to make up our system to those worked under LIV.

(30) Total interest $= £3,219\ 15s. - £2,700 = £519\ 15s.$

Now interest of £2700 for 1 year at $2\frac{3}{4}$ per cent.

$$= \frac{2700 \times 2\frac{3}{4}}{100} \therefore Ans. = \frac{£519\frac{3}{4}}{\frac{2700 \times 2\frac{3}{4}}{100}} = \frac{\overset{189}{\cancel{20}\cancel{7}\cancel{9}} \times \cancel{100} \times \cancel{4}}{\cancel{4} \times \cancel{2700} \times \cancel{11}} = 7 \text{ years.}$$

(39) $Ans. = \frac{\overset{9}{\cancel{6}\cancel{3}\cancel{0}}}{\cancel{7} \times 24 \times 60 \times \cancel{60}} = \frac{\overset{\cdot 3}{\cancel{\cdot 9}}}{24 \times \overset{2}{\cancel{60}} \times \cancel{6}} = \frac{\cdot 3}{24 \times 12} = \frac{\cdot 025}{24}$

$$= \frac{\cdot 00625}{6} = \cdot 0010416\dot{}$$

XLIX.

We work two questions.

(29) 1230 articles $= 102\frac{1}{2}$ dozens.

$102\frac{1}{2}$ at £1 3s. 7d.

1

£102 10 0 at £1 per doz.

3s. 4d. $= \frac{1}{6}$ of £1 | 17 1 8

$2\frac{1}{2}d. = \frac{1}{16}$ of 3s. 4d. | 1 1 $4\frac{1}{4}$

$\frac{1}{2}d. = \frac{1}{5}$ of $2\frac{1}{2}d.$ | 0 4 $3\frac{1}{4}$

£120 17 $3\frac{1}{2}$ *Ans.*

39) $Ans. = \frac{10\frac{1}{2}}{2\frac{1}{3} \times 112} = \frac{21 \times \cancel{2}}{\cancel{2} \times 5 \times 112} = \frac{3}{5 \times 16} = \frac{\cdot 06}{16}$

$= \cdot 00375$ *Ans.*

L.

Here we deal with the two most difficult questions.

(28) $7 : 2 :: 42 : 12$ rate of sail per hour

$\therefore$ *Ans.* $= 342 \div 12 = 28\frac{1}{2}$ hrs.

(29)

	£	s	
2 qrs. $= \frac{1}{91}$ of a ton	0	2	11
14 lbs. $= \frac{1}{8}$ of 2 qrs.	0	0	$8\frac{3}{4}$
	£0	3	$7\frac{3}{4}$

LI.

The questions are of the ordinary kind until we reach

(15) If 5 oxen $= 7$ horses. 1 ox. $= 1\frac{2}{5}$, and 2 oxen $= 2\frac{4}{5}$ horses

Then $5\frac{4}{5} : 7 :: 87 : Ans.$ $\therefore$ *Ans.* $= \dfrac{7 \times 87 \times 5}{29} = 105$

(30) Whole int. $=$ £462 7*s.* $3\frac{1}{2}$*d.* $-$ £369 17*s.* 10*d.* $=$ £92 9*s.* $5\frac{1}{2}$*d.*

Now interest for 1 year $= \dfrac{\text{£369 17}s.\ 10 \times 2\frac{1}{2}}{100} = \dfrac{\text{£92 9}s.\ 5\frac{1}{2}d.}{10}$

$= \therefore$ *Ans.* $= 10$ years.

LII.

(2) $29 = 2$ doz. and 5

	£		
	£3	16	6
			2
$4 = \frac{1}{7}$ of a doz.	7	13	0 price of 2 dozen.
$1 = \frac{1}{4}$ of 4 „	1	5	6
	0	6	$4\frac{1}{2}$
	£9	4	$10\frac{1}{2}$

(15) 55 : 60 :: $5\frac{1}{2}$*d.* : first cost of loaf in latter case

$= \dfrac{60 \times 11}{55 \times 2} = 6d.$ Now $400 \times 6d. = £10$; $\therefore$ *Ans.* $= 10s.$

(26) *Ans.* $= \dfrac{121121}{1760 \times 36} = \dfrac{11011}{160 \times 36} = \dfrac{688{\cdot}1875}{36} = \dfrac{114{\cdot}697916}{6}$

$= 19{\cdot}1163194$.

LIII.

(17) *In some* editions the time was $4\frac{1}{4}$ years. This made it rather *difficult*, as an elementary question.

LIV.

(1)
$$2\tfrac{1}{4}\ \begin{cases} 4)721572 \text{ grs.} \\ 6)180393 \\ 2,0)3006,5 \quad ,, \quad 12 \text{ grs.} \\ 12)1503 \quad ,, \quad 5 \text{ dwts.} \end{cases}$$
125 lbs. 3 oz. 5 dwt. 12 grs. *Ans.*

(2)
$$£7 : 3s. :: 1 \text{ ton}$$
$$\cdot \quad 4$$
$$\frac{3 \times \cancel{20} \times 4 \times \cancel{28}}{\cancel{7} \times \cancel{20}} = 48 \text{ lbs. } Ans.$$

(3)
$6s.\ 8d. = \frac{1}{3}$ of £1 | £1430 12*s.*
476 17 4 div. at 6*s.* 8*d.* in the pound
£953 14*s.* 8*d.* ,, 13*s.* 4*d.* ,,

(4)
$$\frac{£435\frac{3}{4} \times 2 \times 2\frac{1}{2}}{100} = \frac{1743 \times \cancel{2} \times \cancel{5}}{\cancel{100} \times 4 \times \cancel{2}} = \frac{£174,3}{8,0} = £21\ 15s.\ 9d.$$

(5)
$$8\tfrac{1}{7} + \tfrac{9}{14} + 4\tfrac{5}{21} + 2\tfrac{17}{42} = 14 + \frac{6+27+10+17}{42} = 14\frac{\cancel{60}^{10}}{\cancel{42}_{7}} = 15\tfrac{3}{7}\ Ans.$$

(6)
$$8\tfrac{1}{30} - 3\tfrac{4}{45} = 8\tfrac{3}{90} - 3\tfrac{8}{90} = 4\tfrac{85}{90} = 4\tfrac{17}{18}\ Ans.$$

(7)
$$9\tfrac{5}{11} \times 4\tfrac{1}{8} = \frac{\cancel{104}^{13}}{\cancel{11}} \times \frac{\cancel{33}^{3}}{\cancel{8}} = 39\ Ans.$$

(8)
$$72\tfrac{1}{2} \div 7\tfrac{1}{4} = \frac{\cancel{145}^{5}}{\cancel{2}} \times \frac{\cancel{4}^{2}}{\cancel{29}} = 10\ Ans.$$

(9)
·813
420·91
·00093
7·043
12560·
12988·76693 Ans.

(11)
757·04
· 15·8
605632
378520
75704
11961·232

(10) 506·222
59·87
446·352 *Ans.*

(12) 543·140) 22·0970 (·041 nearly
217256
37140

(13) £2·622
20
12·500
12
6·00

∴ £2 12*s.* 6*d.* *Ans.*

(14) 12)5864542 in.
3)488711 .. 10 in.
162903 .. 2 ft.
2
11)325806 half-yds.
4,0)2961,8 $\frac{8}{2}$ = 4 yds.
8)740 .. 18 pls.
92 mls. 4 fur. 18 pls. 4 yds. 2 ft. 10 in. *Ans.*

(15) Required rate = $\frac{23\frac{3}{4}}{2\frac{1}{2}} = \frac{95}{10} = 9\frac{1}{2}$ *Ans.*

(16) 7 oz. 14 dwts. 21 grs. at £2 13*s.* 4*d.* per oz.

	2	2	1	
	15	9	9	price at £2 „
13*s.* 4*d.* = $\frac{1}{3}$ of £2	5	3	3	„ 13*s.* 4*d.* „
	£20	13*s.*	0*d.*	„ £2 13*s.* 4*d.* „

(17) $(1{\cdot}035)^4 = 1{\cdot}147523000625$ amount of £1 in 4 years.
9
10·327707005625 „ £9 „
£300
3098·312101687500£
20
6·24203750 0*s.*
12
2·9044500*d.*

∴ £3098 6*s.* 2·90445*d.* *Ans.*

$2\frac{1}{9} + \frac{7}{15} + 2\frac{7}{20} + \frac{7}{45} = 14 + \frac{20+84+63+28}{180} = 15\frac{1}{12}$ *Ans.*

$4\frac{6}{52} - \frac{10}{52} = 3\frac{3}{4}$ *Ans.*

$$18\tfrac{3}{4} \times 1\tfrac{13}{15} = \frac{\overset{5}{\cancel{75}}}{\underset{4}{\cancel{4}}} \times \frac{\overset{7}{\cancel{28}}}{\underset{1}{\cancel{15}}} = 35 \text{ } \textit{Ans.}$$

$$1\tfrac{7}{22} \div 8\tfrac{2}{7} = \frac{\cancel{29}}{\underset{2}{\cancel{22}}} \times \frac{7}{\cancel{28}} = \tfrac{7}{44} \text{ } \textit{Ans.}$$

5004·46
·579
1201·043
5206·082

(23) 75·
19·9876
55·0124

45·267
7·045
226335
181068
316869
318·906015

(25) ·0065)15·9600
13) 3192
1) 245·538461

$$\frac{18s.\ 8\frac{1}{4}d.}{2s.\ 2d.} = \frac{224{\cdot}25}{26} = \frac{112{\cdot}125}{13} = 8{\cdot}625 \text{ } \textit{Ans.}$$

5 acres 13 poles
4
20 roods
40
813 poles
30¼
24390
203¼
24573¼ yards.
9
221339¼ square feet. *Ans.*

(28) $\frac{1}{2}$ of $4\frac{1}{8}$ cwt. : 195 lbs. :: 21 *guineas* : *Ans.*

$$\therefore \text{Required price} = \frac{\overset{71}{\cancel{781}} \times \overset{2}{\cancel{8}} \times \overset{7}{\cancel{21}} \times 21}{\underset{3}{\cancel{4}} \times \underset{10}{\cancel{33}} \times \underset{16}{\cancel{20}} \times \cancel{112}} = \frac{149,1}{16,0} = £9\ 6s.\ 4\tfrac{1}{2}$$

(29) 34 c. yds. 3 ft. 288 in. at £3 6*s.* 9*d.* per yd.

			2		
	6	13	6	price of 2 yd	
			17		
	113	9	6	,,	34 ,,
3 ft. = $\frac{1}{9}$ of 1 yd.	0	7	5	,,	3 ft.
288 in. = $\frac{1}{18}$ of 3 yds.	0	0	$4\frac{17}{18}$	,,	280 in.
	£112	17	$3\frac{17}{18}$. *Ans.*		

(30) Required time = the given sum divided by its int
for one year $= \frac{£2220}{\frac{2220 \times 6}{100}} = \frac{2220 \times 100}{2220 \times 6} = 16\frac{2}{3}$ years.

(31) $\frac{7}{16} + 6\frac{5}{48} + 2\frac{5}{8} + \frac{13}{24} = 8 + \frac{21+5+40+26}{48} = 9\frac{11}{12}$ *Ans.*

(32) $11\frac{3}{44} - 6\frac{15}{22} = 11\frac{3}{44} - 7\frac{30}{44} = 3\frac{17}{44}$ *Ans.*

(33) $\frac{19}{20} \times 11\frac{1}{9} \times 3\frac{21}{38} = \frac{\cancel{19}}{\cancel{20}} \times \frac{\overset{5}{\cancel{100}}}{9} \times \frac{\overset{15}{\cancel{135}}}{\underset{2}{\cancel{38}}} = \frac{75}{2} = 37\frac{1}{2}$.

(34) $7\frac{7}{11} \div 3\frac{3}{55} = \frac{\cancel{84}}{\cancel{11}} \times \frac{\overset{5}{\cancel{55}}}{\underset{2}{\cancel{168}}} = 2\frac{1}{2}$ *Ans.*

(35)

	1824·2764
	176·09032
	·47
	2000·83672 *Ans.*

(37)

	974·01
	7·045
	487005
	389604
	681807
	6861·90045 *Ans*

(36) 872·70032
7·20147
865·49885 *Ans.*

(38) 2470·000) 1·765 (·00071 *Ans.*
1729
360

(39) $\frac{1s.\ 2d.}{12s.\ 8\frac{1}{4}d.} = \frac{14}{1682 \cdot 25} = \frac{8}{87} = \cdot 09195 \ldots$ *Ans.*
2
21·75

LIV.*

(15) Here in first instance bread is 2d. a lb. or 5*s.* for 30 lbs. but when wheat is 40*s.* a qr. the loaf will be cheaper than when it was 60*s.*

$$\therefore \textit{Ans.} = \frac{40 \times 5s.}{60} = 3s.\ 4d.$$

(16) 12 cwts. 3 qrs. $3\frac{1}{2}$ lbs. @ £2 8
12

	£28	16	0	price of 12 cwts.
2 qrs. = ½ of 1 cwt.	1	4	0	
1 qr. = ½ of 2 qrs.	0	12	0	
$3\frac{1}{2}$ lbs = ⅛ of 1 qr.	0	1	6	
	£30	13	6	*Ans.*

(35) Here 2·453 of a day = 2·453 × 24 = 58·872 of an hour. Then 58·872 + ·055 = 58·927 hrs. Then multiply by 60 for the *Ans.*

LV.

(28) Here 4 m. an hour = 4 × 1760 ÷ 60 = $117\frac{1}{3}$ yds. per minute, or 352 feet. ∴ *Ans.* = 352 × 600 × 30 = 6336000, and its weight is 6336000 × 1000 ounces.

(29) In 24 hrs. they differ 15″; consequently in 4 days they will differ 1′, or 30′ in 120 days. Now the one that gains 8″ a day has gained 960″ = 16′, and points to 16′ past 12 o'clock, while the other is 11 hrs. 46′.

(30) Filling pipes = ½ + ⅓ = ⅚ in an hour. Now actual quantity filled in an hour = ⅚ − ⅕ = $\frac{19}{30}$; ∴ *Ans.* = 30 ÷ 19 = $1\frac{11}{19}$ hrs.

LVI.

(8) $11{\cdot}83 \div 26 = 5{\cdot}915 \div 13 = {\cdot}455$ *Ans.*

(9) £1 13*s.* 4*d.* = 400*d.*; then $\cdot 275 \times 400 = 110$ *Ans.*

(12) $$Ans. = \frac{£635 \times 9 \times 3\frac{1}{4}}{100} = \frac{127 \times 9 \times 13}{20 \times 4} = 1485{,}9 \div 8\not{0}$$
$$= £185\ 14s.\ 9d.$$

(27) Since $\frac{1}{5}$ of 4*s.* 11*d.* = $11\frac{4}{5}d.$ we have $\frac{3}{5} = 2s.\ 11\frac{2}{5}d.$ Then cost per oz. = $7s.\ 10\frac{2}{5}d.$; $\therefore$ *Ans.* = $7s.\ 10\frac{2}{5}d. \times 45$ = £1 19*s.* 4*d* × 9 = £17 14*s.*

LVII.

(4) This should be done by factors in the order $5 \times 9 \times 7$.

No comment is necessary on any of the others until we come to

(12) $$Ans. = 4\frac{\overset{1}{\not{1}\not{1}}}{\not{1}\not{1}\not{1}} \times 1\frac{\not{1}\not{2}\not{3}}{\not{1}\not{1}\not{8}\not{0}} \times £12 = \frac{405}{\not{1}\not{0}\not{1}} \times \frac{\not{1}\not{0}\not{1}}{\not{6}\not{0}} \times £\not{1}\not{2} = £81.$$
$$101 \qquad 60 \qquad\qquad 5$$

(13) $$Ans. = 24 \times 2\tfrac{3}{4} \times 2\tfrac{1}{2} \times 11\tfrac{10}{11} \text{ lbs.}$$

$$= \overset{3}{\not{2}\not{4}} \times \frac{\not{1}\not{1}}{\not{4}} \times \frac{5}{\not{2}} \times \frac{131}{\not{1}\not{1}} = 1965 \text{ lbs.}$$
$$1$$

(16)
$$A = 200 \times 6 + 50 \times 6 + 100 \times 3 = 1800$$
$$B = 150 \times 9 + 50 \times 3 \qquad = 1500$$
$$C = 100 \times 6 + 250 \times 6 \qquad = 2100$$

Now divide £270, as 18 : 15 : 21, or as 6 : 5 : 7.

LVIII.

) Discount on £101¼ for 3 m. at 5 = £1¼.

$$\text{Interest} = \frac{\overset{81}{\cancel{405}} \times 3 \times \cancel{5}}{4 \times \cancel{1200}} = \frac{81 \times 3}{4 \times 48} = £1\tfrac{17}{64}$$

$\overset{240}{\cancel{240}}$
48

$\therefore$ Difference = $£\frac{1}{64}$. Now $\frac{1}{64} : \frac{9}{480} :: £101\frac{1}{4}$

$$\therefore Ans. = \frac{\overset{3}{\cancel{9}} \times \overset{81}{\cancel{405}} \times \overset{16}{\cancel{64}}}{\underset{96}{\cancel{480}} \times \underset{1}{\cancel{64}} \times \cancel{4}} = \frac{3888}{32} = £121\ 10s.$$

) Compound interest on £1 = $(1{\cdot}04)^4 = 0{\cdot}16985856$

Simple interest on £ = $\frac{1 \times 4 \times 4}{100} = \cdot 16$

Difference = $\overline{0{\cdot}00985856}$

$\therefore Ans. = {\cdot}00985856 \times £1800$

) Find as above the difference on £1, and then use a state

) Since 13 tons 7 cwts. 3 qrs. 12 lbs. = 30000 lbs.

$$Ans. = \left(\frac{23}{315} \times \frac{44}{31} \div \frac{50}{63} \times \frac{15}{31}\right) \times \frac{30000}{2240}.$$

$$= \frac{23}{\underset{45}{\cancel{315}}} \times \frac{\overset{11}{\cancel{44}}}{\cancel{31}} \times \frac{\overset{9}{\cancel{63}}}{50} \times \frac{\cancel{31}}{\cancel{15}} \times \frac{\overset{20}{\cancel{30000}}}{\underset{56}{\cancel{224}}}$$

$$= \frac{23}{\underset{15}{\cancel{45}}} \times \frac{\overset{33}{\cancel{99}}}{\cancel{5}} \times \frac{\overset{4}{\cancel{20}}}{\underset{14}{\cancel{56}}} = \frac{759}{15 \times 14} = \frac{50{\cdot}6}{14} = 3{\cdot}6\dot{1}4285\dot{7}$$

(5) $Ans. = \frac{1771 \times 20}{105} + \frac{1771 \times 100}{110} + \frac{1771 \times 100}{115}$

$= 1686\frac{8}{9} + 1610 + 1540 = £5036\frac{8}{9}$

(6) $Ans. = \frac{1{\cdot}35416 \times 21}{20} \times \frac{{\cdot}0359375}{1{\cdot}203125} \times 2240$ lbs.

$= \frac{1\frac{17}{48} \times 21}{20} \times \frac{23}{640} \times \frac{2240}{1\frac{5}{64}} = \frac{65}{48} \times \frac{21}{20} \times \frac{23}{640} \times \frac{2240 \times 64}{77}$

$= \frac{2093}{22} = 95{\cdot}136$ lbs.

(7) £14 per cwt. $= \frac{14 \times 20}{112} = 2s.\ 6d.$ per lb.

$\therefore$ gain per lb. $= 3\frac{3}{4}d. = \frac{15}{120} = \frac{1}{8}$ or $12\frac{1}{2}$ per cent.

Consequently, selling for £55 15*s.* $3\frac{3}{4}d.$ would be selli at $7\frac{1}{2}$ per cent. profit.

$\therefore Ans. = \frac{£55\ 15s.\ 3\frac{3}{4}d \times 100}{107\frac{1}{2} \times 2s.\ 6d.}$ lbs. $= \frac{83}{\frac{215}{43} \times \frac{120}{6}} \times \frac{5}{2}$

$= 415$ lbs. $= 3$ c. 2 qrs. 23 lbs.

(8) On £1 rent he pays $11d. + 3s. 5\frac{3}{5}d. + 9\frac{3}{5}d. = 5s.\ 2\frac{1}{5}d.$

Now £22 0s. 7d. $\div$ $5s.\ 11\frac{4}{5}$d. $= 85$ *Ans.*

LIX.

) $\text{Ans.} = \dfrac{18\frac{1}{2} \times 12\frac{1}{2} \times 4 \times 39d.}{9 \times 3 \times 240} = \dfrac{37 \times 25 \times 13}{2 \times 2 \times 9 \times 60} = \dfrac{2405}{432} = \underset{\pounds}{5}\ \underset{s.}{11}\ \underset{d.}{4\frac{1}{9}}$

Reason—Number of sq. yds. in room $= 18\frac{1}{2} \times 12\frac{1}{2} \div 9$; but as the carpet is only $\frac{3}{4}$ yd. wide, more yards of it will be required in the ratio 3:4; and since $3s. 3d. = 39d.$, we multiply by 39, and divide by 240 for answer in pounds.

) To perform 6 times as great a work would require $6 \times 20 = 120$ men, and to do this in $\frac{1}{10}$ of the time, would require $120 \times 10 = 1200$ men. *Ans.*

) $(20 \times 4840) : (384 \times 300) :: 3 : 9$ *Ans.*
$4 : 11$
$12 : 11$

) Total distance = (12 mls. 3 fur. 9 pls. 4 yds. × 12) ÷ 7

$\therefore$ *Ans.* in hours = 12 mls. 3 fur. 9 pls. 4 yds. $\times \dfrac{12}{7}$

$= 12\frac{1}{3}\frac{4}{5}\frac{7}{2}\frac{}{0} \times \dfrac{12}{7} = 21$ hrs. $15\frac{3}{3}\frac{0}{0}\frac{3}{8}$ m.

) Here $50s. + 37\frac{1}{2}s. \times 3 \times 14s. \times 11 = £15\ 16s.\ 6d.$, the wages of 15 men.

$$\therefore \text{ Ans.} = \frac{£94\ 19s.}{£15\ 16s.\ 6d.} \times 15 = 6 \times 15 = 90$$

10) 128 galls. at $8s.\ 6d. = £54\ 8s.$ He must sell as many galls. at $5s.\ 0d.$ each as will produce $£54\ 8s. + £8\ 8s. = £62\ 16s.$; $\therefore$ £62 16s. ÷ 5s. $= 251\frac{1}{5}$

$\therefore$ *Ans.* $= 251\frac{1}{5} - 128 = 123\frac{1}{5}$

LXI.

(1) $21 : 7 :: 160$ in. : metres in diameter $= 1\frac{2}{22}{}^{0} = 50\frac{10}{11}$

$\therefore 50\frac{10}{11}$ metres $= 167$ feet

$\therefore$ a metre : a foot $:: 167 : 50\frac{10}{11} = 1837 : 560.$

(3) $\underset{4 \text{ qrts.}}{\overset{\text{c. in.}}{1728}} : \underset{1 \text{ qrt.}}{\overset{\text{c. in.}}{277{\cdot}274}} :: \overset{\text{oz.}}{1000} : \frac{277274}{6912} - 40\frac{307}{3457}$ oz.

(4) Number of vols. paid for $= \frac{£434\ 7s.}{17s.} = 511$

$\therefore 531 - 511 =$ number of lots of $25 = 20$

Ans. $= 20 \times 25 = 500$

(5)

$\frac{3}{4} \times \frac{5}{9}$ of £2 5*s.*	= 0	18	9
$\frac{2}{7}$ of £3 3*s.*	= 0	18	0
$8\frac{1}{99}$ of £1 18*s.* 6*d.*	= 1	11	6
$2\frac{133}{990}$ of £2 15*s.*	= 5	18	6
	£9	6	9

Now, $\frac{£9\ 6s.\ 9d.}{£26\ 5s.} = \frac{2241}{6300} = \frac{249}{700} = £\cdot 35591428$ *Ans.*

(6) *Ans.* $= \frac{£2377\ 4s.\ 9d. \times 10\frac{1}{4}}{5763 \times 100} = 10\frac{509}{400}d.$

(7) (18 ft. 9 in. $\times$ 16 ft. 9 in.) $\times 2 = 71$ ft. circuit of room

$\therefore$ area in inches $= 852 \times 126$

$\therefore$ *Ans.* $= \frac{852 \times 126 \times 5}{4} = 213 \times 630 = 134190.$

(8) Number of half-sovs in an oz. $= \frac{£3\ 17s.\ 10\frac{1}{2}d.}{10s.} = 7\frac{63}{80}$

It is evident that, in order to have an even numb half-sovs., we must multiply $1\frac{63}{80}$ by 80 the *Ans.*

(9) *36:40*
12:11::20 m. : $\frac{40 \times 20 \times 11}{36 \times 12} = \frac{550}{27} = 20\frac{10}{27}$m. Ans.

0) $Ans. = \frac{10\frac{1}{2}\text{yds.} \times 35\frac{1}{3}}{36} = \frac{21 \times 106}{36 \times 2 \times 3} = \frac{2226}{216} = 10$ yds. 11 in.

1) Sum after 14*d.* in the £ was paid=£486+£2 10*s.*

$\therefore Ans. = \frac{£508\ 10s. \times 240}{226} = £540$

2) $\frac{(72+37) \times 110}{100} - \left(\frac{72 \times 108}{100} \quad \frac{37 \times 112}{100}\right) = 119{\cdot}9 - 119{\cdot}2$

$= {\cdot}7$, the excess of 10 per cent. on the whole, above the sum of 8 per cent. on 72 and 12 per cent. on 37.

$\therefore Ans. = £2\ 13s.\ 1d. \times \frac{10}{7} = 7s.\ 7d. \times 10 = £3\ 15s.\ 10d.$

3) Interest on say

£100 for 75 days=$100 \times \frac{75}{3} = 2500d. = £1\ \ 0\ 10$

Accurate interest=$\frac{100 \times 75 \times 5}{36500} = \frac{£75}{73} = £1\ \ 0\ \ 6\frac{2}{73}$

Therefore error=$3\frac{1}{73}d.$ on this sum, and consequently the rule is incorrect.

4) Daily wage at £3000 per annum=$2000d. - \frac{1}{72}$ of 2000 $= 2000 - 27\frac{7}{9} = 1972\frac{2}{9}d. = £8\ \ 4\ \ 4\frac{2}{9}$

Accurately. £3000÷365=8 4 $4\frac{4}{73}$

$\therefore$ Difference=$\frac{4}{73} - \frac{2}{9} = \frac{2}{657}$, which is less than $\frac{1}{2}d.$

5) $7\frac{1}{2}$ per cent. of 504=37·8 the spirit in 504 galls. Now, of what quantity is this $8\frac{3}{4}$ per cent. ?

$8\frac{3}{4} : 37\frac{4}{5} :: 100 : 432$ galls.

$\therefore Ans. = 504 - 432 = 72$ galls.

6) Expense of 70 ac.=$\frac{70 \times 4 \times 57}{20}$£ — £238=£798 — £238

=*£560, or £8* per acre.

$$\therefore Ans. = \frac{60 \times 5 \times 55}{20}£ - £8 \times 60 = £825 - £480 = £345.$$

(17) Total cost for 12m. = £9 + 18*s.* × 3 = £11 14 0
„ 10m. = 19*s.* 3*d.* × 10 = 9 12 6
„ 2m. of mid-winter = 2 1 6
∴ *Ans.* = £2 1*s.* 6*d.* ÷ 2 = £1 0*s.* 9*d.*

(18) Since (2 men + 1 boy) × 5 = (2 men + 4 boys) × 3
or 10 men + 5 boys = 6 men + 12 boys
Take 6 men and 5 boys from both and 4 men = 7 boys.
∴ 8 men = 14 boys *Ans.*

(19) In calculating the time from his first deposit until the end of 1875, we find he will have made 105 deposits:

$$\therefore Ans. = \frac{£1\ 7s.\ 6d.}{4} \times 105 = £36\ 1s.\ 10\tfrac{1}{2}d.$$

$$(20)\ Ans. = 27 - \frac{£1\ 16s.\ 5d. \times 27}{£2\ 2s.\ 9d.} = 27 - 23 = 4.$$

$$(21)\ \left(1 + \frac{900 + 400 + 225 + 144 + 100}{3600}\right) \times \frac{1239 + 728 - 767}{5969}$$

$$= 1\tfrac{1760}{3600} \times \tfrac{1200}{3369} = \tfrac{5362}{3600} \times \tfrac{1200}{3369} = \tfrac{1}{3}\ Ans.$$

(23) See O, (10), in Appendix.

(25) A = 6, B = 5, C = 4, D = 3 ∴ B, C, and D = 12, or twice as much as A.
∴ If A copies 20, they will all copy 60 per day.

$$\therefore Ans. = \frac{240 - 60}{60} = \frac{180}{60} = 3 \text{ days.}$$

(26) Circumference by one calculation = 7 : 22 :: 4 : 12⅔; by the other = 3 × 4 = 12 feet.

∴ Difference in one turn = $\frac{4}{7}$ of a foot.

∴ $\frac{4}{7}$: (12 × 100) :: 12$\frac{4}{7}$ feet : 5 miles. *Ans.*

LXII.

This paper is very simple up to number 31.

(31) Good debts $= £456\ 18s.\ 1d.$

4s. in the pound on	£360 7s. 10d.	=	72 1	$6\frac{4}{5}$.
5s. „ „	£120 13s.	=	30 3	3
9s. „ „	£19 18s.	=	8 19	$1\frac{1}{5}$
His whole assets are worth			£568 2s.	0d.

Therefore required sum $= \frac{£568\ 2s. \times 20}{£340\ 12s.} = 3s.\ 4d.$
6

(32) His gain $= \left(\frac{75s. \times 101}{100} - \frac{75s. \times 96}{100}\right) \times 77$

$= (75s.\ 9d. - 72s.) \times 77 = £14\ 8s.\ 9d.$

(33) With the wind he goes 10 m. an hour

Against it $\frac{6 \times 60}{50} = 7\frac{1}{5}$ „ „

$\therefore$ Twice force of the wind $= 10 - 7\frac{1}{5} = 2\frac{4}{5}$

$\therefore$ force of the wind $= 1\frac{2}{5}$ m. an hour.

(34) $\frac{£17480 \times 2\frac{3}{4}}{100} = £480\ 14s.$

$\therefore$ £437 : £480 14s. :: 100 : 110

Now 110 − 100 = 10 required rate.

(35) Time by Coach $= 1\frac{3}{9}\frac{8}{} = 15\frac{1}{3}$ hrs.

$\therefore$ „ „ train $= 23 : 11 :: 15\frac{1}{3} := 7\frac{1}{3}$ hrs.

$\therefore$ $15\frac{1}{3} - 7\frac{1}{3} = 8$ hrs. time gained by taking the train.

(36) *This Question only* differs from H (6), in one of the men *resting every* ten miles. Both are worked alike.

(37) Here since $\frac{40000}{7} = 5714\frac{2}{7}$, and since 1st Jan., 1871, was Sunday, the day of the week 40000 days previously was Friday. Again 40000 days = 109 yrs. 215 days. Since the year 1800 was not a leap year, we have in these 109 years only 26 leap years; taking 109 from 1871, and 26 from 215 (days for leap years), we find 1762 the year required, with a deduction of 189 days. Counting back from 1st January, 1762, we find that the 189th day fell on 26th June, 1761.

(38) This question can be worked out by comparing the maximum and minimum value in each instance, and requires a careful process of reasoning which would occupy far too much of our space.

(39) Here $1889 - (81 \times 13) = 836$ work in feet done by 46 men and 8 boys in 11 days or 76 feet in one day; $\therefore$ 8 boys do 81 $- 76 = 5$ feet less than 8 men in a day; but 8 men do $\frac{81 \times 8}{54}$ $= 12$ ft.; consequently 8 boys do 7 ft.

(40) In 8 days 16 men earn $16 \times 2 \times 8s. = £12\ 16s.$; hence 12 boys in 8 days earn £23 4*s.* $-$ £12 16*s.* $=$ £10 8*s.*, or 2*s.* 6*d.* each daily.

(41) See Square and Cube Root.

(42) 400 qrs. at the various prices must be = 100 at sum of the prices, or £5 12*s.* 1*d.* $\times 100 =$ £560 8*s.* 4*d.* To this add $350 \times 3s.\ 6d.$ for *Ans.*

(43), (44), (45), see the Notes in the Arithmetic.

LXIII. Miscellaneous Questions.

Note.—Here we only work such questions as are not elementary.

(1) $110 : 15.27 :: £23 : £3\ 3s.\ 10{\cdot}2763d.$

(10) $\frac{3}{8} \times \frac{2}{9} \times 8$ fur. $= \frac{2}{9} \times \frac{1}{20} \times \frac{20}{7} = \frac{2}{3} - \frac{2}{63} = \frac{40}{63} = 25\frac{25}{63}$ pls.

(11) *Required cost* $= \frac{25 \times 20 \times 51d.}{2\frac{1}{2} \times 3 \times 240} \times$ £14 3s. 4d.

2) 4 lbs : 25 lbs. : : 6*d.* : 25*d.* *Ans.*
60*s.* : 40*s.*

3) Required thickness $= \frac{\text{the solidity}}{\text{given surface}} = \frac{25 \text{ c. ft. } 1044 \text{ in.}}{29 \text{ ft. } 3\text{in.} \times 25 \text{ ft. } 4\text{in.}}$
$= \frac{97\,81\,2}{10\,6\,704} = 1\frac{1}{12}$ in. *Ans.*

4) $\left.\begin{matrix} 100\frac{3}{8} : 98 \\ 3 \times 240d. : 365 \times 2\frac{1}{2}d. \end{matrix}\right\}$: : 100 first income : second income
therefore second income $= \frac{99 \times 5 \times 365 \times 100 \times 8}{2 \times 3 \times 240 \times 803} = 125$
consequently increase per cent $= 125 - 100 = 25$

5) The number of men, women, and children are as 1, 2, 3
$\therefore \frac{1}{6}$ of $336 = 56$ number of men.
If every woman cost $1d.$
,, man ,, $1\frac{1}{3}d.$
,, child ,, $\frac{1}{3}$ of $2\frac{1}{3}d. = \frac{7}{9}d.$

$\therefore$ the division among the men, women, and children will be as $1\frac{1}{3} \times 1 : 1 \times 2 : \frac{7}{9} \times 3 = 1\frac{1}{3} : 2 : 2\frac{1}{3}$.

Now since there were 56 men, the cost of 1 man for 1 day

$$= \frac{£83\ 6 \times 1\frac{1}{3}}{5\frac{6}{3} \times 56 \times 31} = \frac{19992d. \times 4}{17 \times 31 \times 56} = 2\frac{6}{31}d.$$

A woman's cost $= 2\frac{6}{31}d. \times \frac{3}{4} = 2\frac{1}{31}d.$
and a child's ,, $= 4\frac{6}{31} \div 3 = 1\frac{8}{31}d.$

7) $100 - (1\frac{1}{4} \times 5) = 93\frac{3}{4}$.
$\therefore$ *Ans.* $= \frac{£2531\ 5s. \times 100}{93\frac{3}{4}} = £2700.$

8) $\left.\begin{matrix} 5 : 32 \\ 12 : 24 \end{matrix}\right\}$: : 90*s.* ; £57 12*s.* *Ans.*

9) $\left.\begin{matrix} 2 : 1 \\ 1 : \frac{5}{4} \end{matrix}\right\}$: : £57 12*s.* : £36 *Ans.*

11) $\left.\begin{matrix} 365 \text{ days} : 390 \text{ days} \\ £100 : £97\frac{5}{8} \end{matrix}\right\}$: : £92 : £99 1*s.* $11\frac{4}{13}$*d.* Ans.

(22) Cost $= 6948\frac{5}{7} \times 48\frac{7}{8}d. = £1415\ 1s.\ 6\frac{2}{5}\frac{3}{6}d.$
Total gain $= 6948\frac{5}{7} \times \frac{5}{9}d. = £16\ 1s.\ 8\frac{2}{6}\frac{5}{3}d.$
They were issued for the sum of these resul

(23) Amount of £1 in 5 years at 5 per cent. $= 1{\cdot}05^5$
$= 1{\cdot}2762815625$
$\therefore$ Required amount $= £100\frac{1}{3} \times 1{\cdot}2762815625$
$= £128\ 1s.\ 0{\cdot}860025d.$

(27) Here A and B earn 5*s.* 6*d.* in 1 day.
„ A and C earn 5*s.* 10*d.* „
„ B and C earn 6*s.* 4*d.* „
$\therefore$ 2 day's work of A, B, and C $= 17s.\ 8d.$, or 1 day's wo
$= 8s.\ 10d.$
$\therefore$ A's wages $= 8s.\ 10d.$,—$6s.\ 4d. = 2s.\ 6d.$ and so on.

(32) Here A does $\frac{1}{3}$ in 2 days, and there is $\frac{2}{3}$ to be done.
$\therefore Ans. = \frac{2}{3} \div (\frac{1}{6} + \frac{1}{8}) = \frac{2}{3} \div \frac{7}{24} = \frac{16}{7} = 2\frac{2}{7}$ days.

(34) Solidity of 1st cistern $= 9 \times 5\frac{1}{3} \times 2\frac{1}{4} = 108$ cubic feet.
„ of 2nd $= (3850 \times 108) \div 2520 = 165$ „
$\therefore Ans. = 165 \div (8 \times 5\frac{1}{2}) = 3$ ft. 9 in.

(36) He rides 40 miles in 1 hour, and $11\frac{1}{4}$ m. $\times 20 = 4\frac{3}{4}$ hrs.
He will ride 480 in $\frac{480 \times 4\frac{3}{4}}{40} = 57$ hrs.; and 20 miles more
$10 \times 11\frac{1}{4} = 112\frac{1}{2}' = 1$ hr. $52\frac{1}{2}'$.
$\therefore Ans. = 60$ hrs. $- 58$ hrs. $52\frac{1}{2}$ m.

(37) Here B gets $\frac{2}{8}$ and C $\frac{1}{6}$. $\therefore \frac{1}{8} = 27$ ac., and $Ans. = 216$

(38) See Square and Cube Root.

(39) Here 2 c. 1 q. 3 lbs. $= 255$ lbs.; now $255 \div 17 = 15$: he
selling price of all $= 1s.\ 3d. \times 15 = 18s.\ 9d.$, and gain
$15s. = 3s.\ 9d.$ or 25 per cent.

)) Area of walk = 600 sq. feet; $\therefore Ans. = \frac{60\emptyset}{4840 \times 9} = \frac{15}{121 \times 9}$

$= \frac{1{\cdot}166, \text{ \&c.}}{121} = \frac{{\cdot}151515, \text{ \&c}}{11} = {\cdot}0\dot{1}3774$

3) Area of floor = £5 12*s.* ÷ 4*s.* 6*d.* = $24\frac{8}{9}$ sq. yds.

$\therefore$ length = $24\frac{8}{9} \div 4\frac{2}{3} = 224 \div 42 = 5\frac{1}{3}$ yds. = 16 ft.

Again, area of walls = £4 ÷ 1*s.* = 80 sq. yds.

$\therefore$ Height = 80 yds. ÷ (30 ft. × 2) = 720 ÷ 60 = 12 ft.

5) Retail price = $\frac{(100 + 9 + 21) \times 12s.\ 6d.}{100} = 16s.\ 3d.$

6) Whole number of 1st class = 7175622

Do. of 2nd and 3rd „ = 57013659

$\therefore (7175622 \times 100) \div 57013659 = 12{\cdot}58\ldots$

7) Required gain = $\frac{{\cdot}075 \times 7 \times 24 \times 60}{100} = 7{\cdot}56$ minutes.

3) He gets £480 from the house, and the interest according to quarterly payments thus: $4\emptyset \times (2\frac{3}{4} + 2\frac{1}{2} + 2\frac{1}{4} + 2 + 1\frac{3}{4} + 1\frac{1}{2} + 1\frac{1}{4} + 1 + 0\frac{3}{4} + \frac{1}{2} + \frac{1}{4}) \times 4 \div 10\emptyset =$ £29 12*s.*; total income = £509 12*s.*

He pays £426 and interest, which is £71 × $(2\frac{1}{2} + 2 + 1\frac{1}{2} + 1 + \frac{1}{2}) \times 4 \div 100$ = £21 6*s.* Now £509 12*s.* — £447 6*s.* = £62 6*s.* *Ans.*

9) First cost = $\frac{£21 \times 100}{112}$ = £18 15*s.*; Cash he gets = £21 − £1 6*s.* 3*d.* = £19 13*s.* 9*d.* $\therefore$ Actual gain = 18*s.* 9*d.* on £18 15*s.*, or 5 per cent.

0) Here ${\cdot}0\dot{6} + \sqrt{\cdot}09 + \sqrt[3]{\cdot}125 = {\cdot}0\dot{6} + {\cdot}3 + {\cdot}5 = {\cdot}8\dot{6}$.

Now ${\cdot}8\dot{6} \div 3\dot{6} = \frac{6}{11} = 2\frac{4}{11}$. *Ans.*

l) See Square Root.

(52) Dividend which has accrued on $3\frac{1}{2}$ per cents. since 1st April $= 3\frac{1}{2} \times 4 \div 12 = 1\frac{1}{6}$; ∴ their value on 1st April $= 105 - 1\frac{1}{6} = 103\frac{5}{6}$; again, value of 3 per cents. "ex. d" $= \frac{103\frac{5}{6} \times 3}{3\frac{1}{2}} = 89$, to which add $\frac{1}{4}$, *i.e.* dividend that has accrued on them for 1 month, viz., July. ∴ *Ans.* $= 89\frac{1}{4}$.

(53) £126,315 = 1265 hundreds + 15: hence solution below

1263 @ 8*s.* 8*d.*

	10104	
$6d. = \frac{1}{2}$ of 1*s.*	631	6
$2d. = \frac{1}{3}$ of 6*d.*	210	6
$10 = \frac{1}{10}$ of 100		$10\frac{2}{5}$
$5 = \frac{1}{2}$ of 10		$5\frac{1}{5}$
2,0)	1094,7	$3\frac{3}{5}$
	£547 7	$3\frac{3}{5}$ *Ans.*

(54) Average increase = (£365 14*s.* 10*d.* − £282 17*s.* 10*d.*) ÷ 21
= £3 17*s.* 11*d.*
∴ *Ans.* = £293 17*s.* 4*d.* + £3 17*s.* 11*d.* = £297 15*s.* 3*d.*

(55) $102\frac{2}{3} : £126\frac{2}{3} :: 2\frac{2}{3} :$ discount.

$$\therefore \text{Discount} = \frac{380 \times 8 \times 3}{3 \times 3 \times 308} = £3\ 5s.\ 9\tfrac{4}{7}\tfrac{7}{7}d.$$

$$\text{Interest} = \frac{£126\frac{2}{3} \times 4 \times 8}{1200} = £3\ 7s.\ 6\tfrac{2}{3}d.$$

$$\therefore \text{Difference} = £3\ 7s.\ 6\tfrac{2}{3}d. - £3\ 5s.\ 9\tfrac{4}{7}\tfrac{7}{7}d. = 1s.\ 9\tfrac{19}{231}d.$$

$$\text{(58) Population in 1801} = \frac{21121967 \times 100}{193{\cdot}5} = 10915745{\cdot}219\ldots$$

(59) 248 − 12 = 236 half number arriving at second station;

∴ 472 − 96 = 376 = $\frac{2}{3}$ number starting.

∴ *Ans.* = 376 + 188 = 564.

(61) Since $14\frac{2}{7}=\frac{1}{7}$ of 100, we put $\frac{1}{7}$ on the prices, and apply rule p. 194.

$$\left.\begin{matrix}17\frac{1}{7}\\22\frac{6}{7}\\29\frac{5}{7}\\34\frac{2}{7}\end{matrix}\right\} \quad 24 \quad \left\{\begin{matrix}10\frac{2}{7}\\5\frac{5}{7}\\1\frac{1}{7}\\6\frac{6}{7}\end{matrix}\right. \quad \left|\begin{matrix}\therefore Ans.=10\frac{2}{7}:5\frac{5}{7}:1\frac{1}{7}:6\frac{6}{7}\\ \text{or } 72:40:8:48\\ \text{or } 9:5:1:6\end{matrix}\right.$$

(62) Since 4 rods 1 pl. 29 yds. $6\frac{3}{4}$ ft.=44100 ft.

$Ans.=\sqrt{44100}=210$ ft. or 70 yds.

(63) $\frac{5}{10}\times\frac{6}{99}\times 1760$ yds. $=\frac{1760}{27}=5$ yds. 2 ft. $9\frac{1}{2}$ in.

(64) 15:60 as 1:4 Then 1 at 82=82*s.*+ 4 at 50*s.*

=282*s.* cost of 5 doz. But 5 doz. sold for 350*s.*

$$\therefore \frac{350\times 100}{282}=£124\ 2s.\ 3\tfrac{1}{11}d.$$

Gain per cent.=£124 2*s.* $3\frac{1}{11}d.-100=£24$ 2*s.* $3\frac{1}{11}d.$

(66) $(3\times 20s.+11\times 12s.\ 6d.+19\times 7s.\ 1\frac{1}{2}d.+17\times 3s.\ 4\frac{1}{2}.$

$+2\times 1s.\ 6d.)\div 58=393s.\ 3d.\div 58=6s.\ 9\frac{2}{3}\frac{1}{8}d.$ *Ans.*

(67) See Exs. in Discount.

(68) 140:100::(20 × 28):400 *Ans.*

(69) Average in 1852 $=\frac{55331+8271+3999}{5433\cdot9+961\cdot4+680\cdot4}=\frac{67601}{7075\cdot7}$

$=9\cdot553\ldots$In same manner proceed for 1853.

(73) Present worth = £1936 18*s.* − £207 10*s.* 6*d.* = £1729 7*s.* 6*d.*

£1729$\frac{3}{8}$:£100 / 3 yrs.: 1 yr. } ::£207 10s. 6*d.*:4 *Ans.*

(74) XXXI. (59).

(75) *£272:£85::320 guineas*:£105 *i.e.* 5 gain.

(76) From the question a man, a woman, and a child consume daily 4 lbs. of bread at 5*d.* But when it rose to 6*d.*, $3\frac{1}{3}$ lbs. cost 5*d.* Now divide $3\frac{1}{3}$ in the ratio of 4, 3, and 2 for *Ans.*

(79) Income on 20 shares = 73·5 × 25 = 1837·5 francs.

∴ Income on 400,000 shares = 36,750,000 francs = 70 per cent. of gross income; hence total income = 52,500,000 francs, to which add expenses 27,800,000, and gross receipts = 80,300,000 francs = £3,212,000. *Ans.*

(80) Here the mean of the mixture is 992, and proportion is 8 : 69; ∴ *Ans.* = $\frac{69}{77}$.

(81) Required side = $\sqrt{513\text{yds. } 1\text{ft. } 11\text{in.} \times 1628\text{yds. } 0\text{ft. } 11\text{in.}}$
= $\sqrt{18491 \times 58619} = \sqrt{1083923929} = 32923$ in.
= 914 yds. 1 ft. 7 in.

(82) $\frac{3}{6} \times 1\frac{1}{6} + 2\frac{15}{990} \times \frac{11}{14} = \frac{1}{2} + \frac{61}{36} = 2\frac{7}{36}$ *Ans.*

(84) 1 day true time = 24 × 60 = 1440 minutes
1 „ on the fast clock = 1442 „
1 „ „ slow clock = 1436 „
∴ 1442 : 1436 :: 12 days : required time.

$$\therefore \text{Required time} = \frac{1436 \times \overset{6}{\cancel{12}}}{\underset{721}{\cancel{1442}}} = 11 \text{ days } 22 \text{ hrs. } 48\tfrac{12}{721} \text{ m.}$$

(89) Taking the share of a woman as the standard.

share of 64 women	= 64	or 8
„ = 20 men	= 40	„ 5
„ = 96 children	= 32	„ 4
	136	17

$$\left.\begin{matrix} \therefore 17 : 5 \\ 20 : 1 \end{matrix}\right\} :: £3000 : \text{a man's share.}$$

$$\therefore A \text{ man's share} = \frac{£3000 \times 5}{17 \times 20} = £44\ 2s.\ 4\tfrac{4}{17}d.$$

3) $(\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6})$ :: £177 7*s.* $0\frac{3}{4}$*d.* : required term, corresponding to $\frac{1}{3}$; that is, $\frac{£177\ 7s.\ 0\frac{3}{4}d. \times 60}{57 \times 3} = £62\ 4s.\ 7d.$

4) $4{\cdot}0\dot{3}\dot{7} \div {\cdot}1\dot{4}0\dot{7} = 4\frac{1}{30} \times \frac{9990}{1400} = \frac{121}{\cancel{30}} \times \frac{\overset{9}{\cancel{9990}}}{\underset{38}{\cancel{1407}}} = \frac{1089}{38} = \frac{544{\cdot}5}{19}$

$=28{\cdot}6578947368$, &c. Now since we know 19 makes 18 ures in its period, we write the second half by simply taking ch figure of the first half in regular succession from 9.

$\therefore Ans. = 28{\cdot}\dot{6}5789473684\dot{2}1052631\dot{.}$

5) £$532\frac{2}{7}$: £100 } :: 1 year : required time
$4\frac{1}{2}$: $34\frac{5}{7}$ }

$$\therefore \text{Required time} = \frac{100 \times \cancel{24}\cancel{3} \times \cancel{7} \times \cancel{2}}{\cancel{37}\cancel{26} \times \cancel{9} \times \cancel{7}} = 1\frac{31}{69} \text{ year.}$$

6) $13\frac{1}{2} : 14 :: 2s.\ 3d. : 2s.\ 4d.$ *Ans.*

7) 1 lb. tea + 3 lbs. sugar = 6*s.*
or $1\frac{1}{2}$ lb. tea + $4\frac{1}{2}$ „ sugar = 9*s.* } subtract.
but $1\frac{1}{10}$ lb. tea + $4\frac{1}{2}$ „ sugar = 7*s.* }
$\frac{4}{10}$ lb. tea „ „ 2*s.*
$\therefore$ 1 lb. = 5*s.*, and hence sugar, 4*d.* a lb.

8) See XL. Ex. 4.

10) The reason of the following is evident from question:—
5*s.* 4*d.* : 6*s.* 2*d.* :: $(100 + 1\frac{0}{8}0)$: 100 + per centage required

$$\therefore Ans. = \frac{112\frac{1}{2} \times 73}{64} - 100 = 130\frac{5}{64} - 100 = 30\frac{5}{64}$$

15) (*a*) In first instance 1 oz. of silver = £12 ÷ 36 = 6*s.* 8*d.*, and workmanship on 1 oz. = 3*s.* 4*d.*, or half of 6*s.* 8*d.*

$\therefore Ans. = 5 \times 24 \times (6s.\ 8d. + 3s.\ 4d. \times 2)$
$= 120 \times 13s.\ 4d. = £80.$

(106) $\left.\begin{array}{rrr} A=2100\times 12=25200 \\ B=1500\times 12=18000 \\ C=2700\times\ 8=21600 \\ \hline 6300 \qquad 64800 \end{array}\right\}$ or 252 : 180 : 216 or 7 : 5 : 6

$$\therefore\ A\text{'s share}=\frac{630\times 7}{18}=£245$$

(107) His gain = the *difference* between the selling price of the cows and the *present* value of £5000 due 12 m. hence.

(108) 36 hrs. : 10 hrs. :: 10′ : $3\frac{11}{13}$′

$$\therefore\ 10+3\tfrac{11}{13}=13\tfrac{11}{13}'\ \textit{Ans.}$$

(109) Quantity of stock $=\dfrac{5460\times 100}{91}=£6000$

$\left.\begin{array}{l} \text{Gain on } £200=\ 2\times 2\frac{1}{2}=\ £5 \\ \text{Loss on } £5800=58\times 6\ =348 \end{array}\right\}$ ∴ loss £343

Now difference in income

$$=\frac{(£5460-£343)\times 4\frac{1}{2}}{120}-\frac{£6000\times 3}{100}=£45\ 15s.\ \text{increase.}$$

(110) If £100 were the cost, then £125 would be the total expense. Now 1 per cent. on 125 = 125 + $1\frac{1}{4}$ = $126\frac{1}{4}$. Again, 5 per cent. off 125 = 125 − $6\frac{1}{4}$ = $118\frac{3}{4}$; ∴ $126\frac{1}{4}-118\frac{3}{4}$ = $7\frac{1}{2}$ the difference had first cost been £100.

$$\therefore\ 7\tfrac{1}{2}:3::100:£40.\ \textit{Ans.}$$

(111) See Exs. under XXXII.

(112) Average gain in 176 days.

$$=\left\{\left(\tfrac{5}{7}+1\tfrac{3}{10}+\tfrac{2}{14}\tfrac{3}{}\right)-\left(1\tfrac{4}{35}+\tfrac{4}{60}\tfrac{3}{}\right)\right\}\times 176\div 5$$

$$=\left(\frac{186}{70}-\frac{349}{420}\right)\times\frac{176}{5}=\frac{134992'}{126000}=1'\ 4{\cdot}28\dot{1}90\dot{4}76''\ \textit{Ans.}$$

(113) First men in 16 days do $\frac{2}{3}$ of $\frac{1}{2}=\frac{1}{3}$, and 16 men do $\frac{1}{3}-\frac{1}{6}=\frac{1}{6}$; consequently there must have been twice as many men, since $\frac{1}{3}$ = twice $\frac{1}{6}$.

115) £45 18*s.* 9*d* = 11025*d.*; then $\sqrt{11025} = 105$. *Ans.*

119) Required difference $= \frac{£12000 \times 5}{103\frac{3}{4}} - \frac{£12000 \times 3}{90\frac{5}{8}}$

$= \frac{£1392000 - £956160}{2407} = £181\ 1s.\ 5\frac{601}{2407}d.$

120) Expense of production = 3900 × 2*s.* 4½*d.* = £463 2*s.* 6*d.*

$\frac{1}{13}$ of 3900 = 300 from 3900 take 3600

25 per cent. of 3600 = 900 from 2700 at 7*s.* 6*d.* = £1012 10*s.*

∴ *Ans.* = (£1012 10*s.* − £463 2*s.* 6*d.*) ÷ 2 = £274 13*s.* 9*d.*

121) Required time $= \frac{£15\ 2s.\ 6d. \times 105}{£75\ 12s.\ 6d.} = 21$ days.

122) Divide in ratios of 152, 19, 29.

123) Required amount $= \frac{£152\ 7s.\ 9d. \times 100}{365d.} = £10020$

127) Time by coach = 69 ÷ 9 = $7\frac{2}{3}$ hrs.

∴ „ train = $7\frac{2}{3} - 4 = 3\frac{2}{3}$ „

Required ratio $3\frac{2}{3} : 7\frac{2}{3}$ = 11 : 23

128) Required difference = *B's* net income − *A's* net income

$= \left(\frac{£33075 \times 4}{94\frac{1}{4}} - \frac{£33075 \times 3}{87\frac{1}{2}}\right) \times \frac{2}{3}\frac{2}{4}\frac{4}{0}$

$= (£1400 - £1134) \times \frac{4}{15} = £248\ 5s.\ 4d.$

129) Required value = $\frac{1}{144}\frac{7}{5} = 1$ lb. 2 oz. 11 dwts. 16 grs.

132) *A* does $\frac{1}{55}$ and *B* $\frac{1}{66}$ of the work in 1 hour; but *A* does as much in 55 as *B* in 66 hours; ∴ *B* is $\frac{5}{6}$ as good a workman as *A*; ∴ *A* and *B* in one hour can do

$\frac{1}{55} + \frac{1}{\not{6}\not{6}} \times \frac{\not{5}}{6} = \frac{1}{30}$, and in 10 hours (or 1 day) $\frac{10}{30}$ or $\frac{1}{3}$

11 ∴ *Ans.* = 3 days.

E.

(133) Each £100 railway stock = £108 cash = $\frac{108 \times 100}{91\frac{1}{8}}$

ment stock = $\frac{108 \times 100 \times 95\frac{3}{8}}{91\frac{1}{8} \times 100}$ cash, $= 113\frac{1}{27}$

∴ Gain on every £100 railway stock = $113\frac{1}{27} - 109$

∴ Amount of stock = $\frac{109 \times £100}{4\frac{1}{27}} = £2700$

(134) Circuit of room = (19 ft. $10\frac{1}{2}$ in. + 16 ft. $1\frac{3}{4}$ in.) ×
= 73 ft. $6\frac{1}{2}$ in.

∴ Required cost = $\frac{73{\cdot}5416 \times 10{\cdot}25 \times 51d.}{9 \times 12 \times 20} = £6\ 9s.$

(137) £157 5*s.* 10*d.* − £7 4*s.* × 6 = £114 1*s.* 10*d.*

∴ Required sum.

$= \left(\frac{£157\ 5s.\ 10d. \times 104}{100} - £114\ 1s.\ 10d.\right) \div 8 = £15\ 0$

(142) From the question 6 times the stride of first =
the stride of second

∴ Gain of first over second = 7 × 5 − 6 × 4 = 11 i

∴ Required gain = $\frac{4 \times 11 \times 1760 \text{ yds.}}{35} = 2212\frac{4}{7}$

(143) 233 : 240 :: £959 3*s.* 8*d.* : *Ans.*
95 : 100

$\therefore Ans. = \frac{\overset{50}{\cancel{£959}}\ \overset{9}{\cancel{3s.}}\ \overset{8}{\cancel{8d.}} \times 240 \times \overset{20}{\cancel{100}}}{233 \times \underset{19}{\cancel{95}}} = £104$

(145) See XXXVIII., Ex. 7. (146) See (105) above a

(147) The sum = $(£210\frac{3}{20} \times 5\frac{5}{12}) \div 3\frac{1}{4} = £350\ 5s.$

(148) Required number = $\frac{(88\frac{3}{8} \times 1000)}{100 \times 8\frac{3}{4}} = 101.$

1) Quantity of stock bought $= \frac{£1911 \times 150}{79\frac{5}{8}} = £2400$

$\therefore$ Required price $= \frac{1}{8} + \frac{(£1911+150)}{24} = £86.$

5) First income $= (£5617\ 10s. \times 3) \div 93\frac{5}{8} = £180.$

Now 3 : 5 :: 180 : £280 16*s.* $10\frac{2}{87}$d.

$97\frac{1}{8} : 91\frac{5}{8}$ $\therefore$ *Ans.* $= £100\ 16s.\ 10\frac{2}{87}d.$

6) Required number

$$= \left(\frac{38+74}{2} \times 35 \times \tfrac{3}{4} \times 8 \times 40 \times 1\tfrac{1}{2} \times 3\right) \div 27 = 287466\tfrac{2}{3}.$$

7) First gains $\frac{1}{2}$ a mile per hour on second ; $\therefore$ he will gain $6 - 4 = 2$ miles in 4 hours

$\therefore$ Required distance $= 5 \times 4 + 3\frac{1}{2} \times 4 = 34$ miles.

9) Here 3 (greater $-$ 18) $= 2$ (18 $-$ the less) or 3 times greater $- 54 = 36 -$ twice the less, or 3 times greater + twice the less $= 90$; but twice greater + twice the less $= 68$

$\therefore$ greater $= 90 - 68 = 22$ *Ans.*

1) She receives $3\frac{3}{4} \times 5 - 12 = 6\frac{3}{4}$ tons an hour

$\therefore$ She will sink in $60 \div 6\frac{3}{4} = 8\frac{8}{9}$ hrs.

$\therefore$ Required rate $= 40 \div 8\frac{8}{9} = 4\frac{1}{2}$ miles per hour.

2)

Stock at first,	£8975	
Goods bought,	3782	
Rent,	75	
Wages $= 5023 \times 7\frac{1}{2} \div 100 =$	376	14*s.* 6*d.*
	£13208	14*s.* 6*d.*
Stock at end $=$	£8763	
Goods sold $=$	5023	
	£13786	

$\therefore$ *Ans.* $=$ £13786 $-$ £13208 14*s.* 6*d.* $=$ £577 5*s.* 6*d.*

3) A sidereal hour $= 23$ hrs. 56′ 4·09″ $\div 24 = \frac{86164.09''}{2400}$

And since 24 hrs. $= 86400''$

$$\textit{Ans.} = 86400'' \div \frac{86164.09}{2400} = 24 \text{ hrs. } 3' 56{\cdot}55$$

5) *Cost* $= (6 \cdot 4\frac{2}{7} \times 36 \times 1\frac{11}{90} \times 36) \times 25s. = £18630.$

(167) Interest = £607 18*s.* − (340+220) = £47 18*s.*

Interest on £220 for 1 yr. at 5 per cent. = £11.

∴ Interest on all after first year = £47 18*s.* − £11 = £36 1

Interest of £220 at 5 per cent. + £340 at 4 per cent.
= £24 12*s.* for 1 year.

∴ Required time of second = £36 18*s.* ÷ £24 12*s.*
= 1½ year, to which add first year; ∴ *Ans.* = 2½ years.

(168) *C* paid $\frac{£605\frac{9}{10} \times 100}{106} = \frac{£30295}{53}$

B „ $\frac{£30295}{53} - \frac{203}{5} = \frac{£140716}{265}$

A „ $\frac{£140716 \times 100 \times 2}{265 \times 209 \times 12 \times 126} = \frac{£703580}{2093053} = 6s.\ 8\frac{1}{2}d.$ near

(169) Gain in 3 months = £412 10*s.* — £375 = £37 10*s.*

∴ Gain per cent. $= \frac{£37\ 10s. \times 100 \times 4}{375} = 40$

(170) Contents of cistern = $10^3 + 2^3 = 1008$ in.

Area of base = $(1\frac{2}{9} \times 1\frac{2}{9}) - (1\frac{1}{9} \times 1\frac{1}{9}) = \frac{7}{27}$ ft. = $1\frac{1}{3}^2$ inch

∴ Depth = $1008 \div 1\frac{1}{3}^2 = 27$ in.

(171) Area of walls = $36 \times 2 \times 9$

„ doors and windows = $6 \times 3 \times 5$

∴ Required number of yards = $\frac{(36 \times 2 \times 9 - 6 \times 3 \times 5)}{9 \times 3} \times$

$= {}^2\frac{2}{2}\frac{3}{7}^2 = 82\frac{2}{3}$

(172) 278 lbs. : 230 tons :: $\frac{18 \times 17 \times 7}{1728} : 2297\frac{101}{117}$ *Ans.*

(173) Required number $\frac{69\frac{1}{22} \times 1760 \times 35}{32} = 111104$

(180) Quantity filled in a minute = $\frac{1}{30} + \frac{1}{40} - \frac{1}{20} = \frac{1}{120}$

∴ the cistern will be filled in 120 mins. or 2 hrs.

1) $\frac{1}{2} = \cdot 5$

$\frac{1}{2 \times 3} = \cdot 1666666$

$\frac{1}{6 \times 4} = \cdot 0416666$

$\frac{1}{24 \times 5} = \cdot 0083333$

$\frac{1}{120 \times 6} = \cdot 0013888$

$\frac{1}{720 \times 7} = \cdot 0001984\ldots$

$\frac{1}{5040 \times 8} = \cdot 0000248\ldots$

$\frac{1}{40320 \times 9} = \cdot 0000027\ldots$

$\frac{1}{362880 \times 10} = \cdot 0000002$

$\cdot 7182818$

Each successive result is easily obtained from the previous one by dividing by 2, 3, 4, &c.: thus the third result = ·16666 &c. ÷4; the fourth = ·0416, &c. ÷5, and so on. In adding up the right hand column we carry 1 for every 9. Had we found the values of the fractions to 8 places we should have found 9 in the 7th place in final result. Any further divisions would evidently not affect the required answer.

32) From the nature of the chronometers

$(212 - 32) : 80 :: (62 - 32) :$ Reaumur's mark

$\therefore$ Reaumur's mark $= \frac{80 \times 30}{180} = 13\frac{1}{3}$

d Statement $180 : 80 :: 22 : 9\frac{7}{9}$ which is expressed $-9\frac{7}{9}°$

l " $180 : 80 :: 50 : 22\frac{2}{9}$, that is $-22\frac{2}{9}°$ *Ans.*

) His gain $= \left(\frac{£27851\ 17s.\ 3d.}{78\frac{3}{8}} - \frac{£27851\ 17s.\ 3d.}{95\frac{3}{16}} \right) \times \frac{1}{16}$

$= £3\ 18s.\ 5\frac{1}{2}d.$

) Solidity $= 600 \div 6\frac{1}{4} = 96$ cubic feet. Now

$$\frac{\overset{3}{\cancel{96}} \times \overset{576}{\cancel{1728}}}{\underset{67}{\cancel{201}} \times \cancel{32}} = \frac{1728}{67} = 25\frac{53}{67} \text{ inches.}$$

$\therefore$ *Ans.* $= 30 - 25\frac{53}{67} = 4\frac{14}{67}$ inches.

(185) Here rates of trains as 5 : 3 ; but owing to accident they run as 3 : 1. Now since the slow train should have done the journey in $3\frac{1}{3}$ hrs., and it took it 3 times as long as the other;

Ans. $= 6 - 3\frac{1}{3} = 2\frac{2}{3}$ hours.

(190)

$3 \times 8 = 24$	4×9	$= 36$
$2 \times 11 = 22$	2×10	$= 20$
$2 \times 12 = 24$	4×13	$= 52$
$7)$ 70	4×10	$= 40$
Average of boys $= 10$	7×10	$= 70$
	$21)$	218
	Average of all	$= 10\frac{8}{21}$

(192) Since £34 4s. = 342 *florins.*

$$\text{Required number} = 342 - \frac{577{\cdot}50 \times 10}{26{\cdot}25} = 342 - 220 = 122$$

(193) Area of floor in yards = £6 2*s.* 6*d.* ÷ 5*s.* = $24\frac{1}{2}$

$$\therefore \text{Breadth of room} = \sqrt{\frac{24\frac{1}{2}}{2}} = \sqrt{\frac{49}{4}} = 3\tfrac{1}{2} \text{ yds.} = 10\tfrac{1}{2} \text{ ft.;}$$

consequently length $= 10\frac{1}{2} \times 2 = 21$ feet

$$\therefore \text{Height} = \frac{\text{area}}{\text{circuit}} = \frac{(£2\ 12s.\ 6d. \div 9d.) \times 9}{63} = \frac{70}{7} = 10 \text{ ft.}$$

(198) £·96 — £·535 = £·425

$$\therefore \textit{Ans.} = \frac{£{\cdot}425}{£4{\cdot}675} = \frac{85}{935} = \frac{1}{11}.$$

(199) See XXVIII. (*a*).

(200) Required number $= (105 + 10) \times 14 \times 60 \times 365$
$= 115 \times 14 \times 60 \times 365 = 35259000.$

(202) Number of solid inches = 1036433728
$\therefore \textit{Ans.} = \sqrt[3]{1036433728} = 1012$ in. $= 28$ yds. 4 in.

(203) $3 : 3\frac{1}{2} :: 72 : 84$ *Ans.*

(204) Required sum = £177 6*s.* $4\frac{1}{2}d. \times \frac{100}{5\frac{1}{4}}$ = £3377 10*s.*

$$\text{Price of stock} = \frac{£3377\frac{1}{2} \times 3}{105} = 96\tfrac{1}{2}$$

5) *Ans.* $= \frac{2s.}{20\frac{1}{2}} \times 2 - \frac{11s.}{57\frac{1}{2}} = \frac{8s.}{41} - \frac{22s.}{115} = \frac{216}{4715}d.$

9) Here $1{\cdot}875 \times 24 \times 60 \times 60 = 162000''$; and

$$\frac{3}{7 \times 24 \times 60 \times 6} = \frac{{\cdot}03}{7 \times 24 \times 6 \times 6} = \frac{{\cdot}01}{7 \times 8 \times 6 \times 6}$$

$$= \frac{{\cdot}00125}{7 \times 6 \times 6} = \frac{{\cdot}000208\dot{3}}{7 \times 6} = \frac{{\cdot}0000347\dot{2}}{7} = {\cdot}00000496031\dot{7}\dot{4}$$

Again $\frac{3}{8 \times 4 \times 2 \times 4 \times 2} = \frac{{\cdot}375}{8 \times 8} = \frac{{\cdot}046875}{8} = {\cdot}005859375$

10) For present worth see "Discount."

$$\frac{\sqrt{8}+\sqrt{5}}{\sqrt{8}-\sqrt{5}} + \frac{\sqrt{8}-\sqrt{5}}{\sqrt{8}+\sqrt{5}} = \frac{8+2\sqrt{8}\sqrt{5}+5+8-2\sqrt{8}\sqrt{5}+5}{8-5}$$

$= \frac{26}{3} = 8\frac{2}{3}$ *Ans.* See Appendix I. in *Arithmetic.*

22) Every 93 brings him $£1\frac{1}{2} + \frac{3}{8} = 1\frac{7}{8}$

$$\therefore \frac{168\frac{3}{4} \times 93}{1\frac{7}{8}} = \text{money in 3 per cents.}$$

$$\text{hence } \textit{Ans.} = \frac{168\frac{3}{4} \times 93 \times 100}{1\frac{7}{8} \times 104\frac{5}{8}} = £8000$$

23) Required loss $= \frac{£70\ 10s. \times 236\frac{1}{2}}{3\frac{1}{2}} = £4763\ 15s.\ 8\frac{4}{7}d.$

24) Use Compound Proportion.

25) A, B, and C in 1 hour can do $\frac{1}{48} + \frac{1}{50} + \frac{1}{72} = \frac{197}{3600}$

$\therefore$ they will do twice the work in $\frac{3600}{197} \times 2 = 36\frac{108}{197}$ hrs.

26) In $1\frac{1}{2}''$ the two trains go the length of both, that is, 176 feet, or 80 m. an hour. Again, in 5" one gains the length of both on the other, or 24 m. an hour. Now use *the principle* "Half sum + half difference = the faster."

(227) At end of 1st year he pays £20 principal, and £5 inter leaving £80 due; at end of second he pays £21 princi and £4 interest, leaving £59 due; at end of third he p £22 1*s.* principal and £2 19*s.* interest, leaving £36 1 due, to which add interest for $\frac{1}{2}$ a-year for *Ans.*

LXIV. Examination Papers.

(8) $\frac{5\cdot1183}{\cdot00705} \times 11\cdot\dot{1} \times \cdot2\dot{9} \times \cdot\dot{1}1\dot{7} = \frac{511830}{705} \times \frac{100}{9} \times \frac{3}{10} \times \frac{116}{990}$

$= 283\frac{5}{9}$ *Ans.*

LXV. Examination Papers.

(1) Required price $= \frac{93 \times 4\frac{1}{2}}{3\frac{1}{4}} = 128\frac{10}{13}$

(2) Since income from £1 in $6\frac{1}{2}$ per cents. $= \frac{6\frac{1}{2}}{128\frac{1}{2}}$

and „ „ £1 „ 3 „ „ $\frac{3}{72\frac{1}{2}}$

$\therefore \frac{6\frac{1}{2}}{128\frac{1}{2}} : \frac{3}{72\frac{1}{2}} :: 100 : 81\frac{303}{377}$

$\therefore$ Loss per cent. $= 100 - 81\frac{303}{377} = 18\frac{74}{377}$

(3) Quantity of stock $= \frac{£5000 \times 100}{70\frac{1}{2}} = £7092\frac{74}{377}$

Required rate $= \frac{100 \times 6}{70\frac{1}{2}} = 8\frac{2}{47}$

(4) See XXXVIII. Ex. 8. (5) See p. 195 in Arithme

(7) Gain $= \frac{1000 \times 3}{4} - \frac{1000 \times 19}{25\cdot4} = £750 - £748\frac{4}{127}$

$= £1\ 19s.\ 4\frac{5}{127}$

8) $\quad Ans. = 920$ *roubles*
$1\ r. = 1{\cdot}2$ *francs*
$25{\cdot}15\ fr. = £1$

$$\therefore \text{Sum paid to broker} = \frac{920 \times 120}{2515} = 43\tfrac{73}{503}$$

Again :—*Ans.* $= 920$ *roubles*
$1\ r. = 1{\cdot}15$ *francs*
$25{\cdot}35\ fr. = £1$

$$\text{Sum broker pays} = \frac{920 \times 115}{2535} = 41\tfrac{73}{507}$$

$$\therefore \text{Required gain} = £43\tfrac{73}{503} - £41\tfrac{73}{507} = £2\ 3s.\ 2\tfrac{52}{85}\tfrac{71}{007}\tfrac{14}{7}d.$$

0) It is evident that $22\frac{1}{2}$ days of $A = 22\frac{1}{2} + 18$ days of B, *i.e.*, $40\frac{1}{2}$ of B.

$$\therefore Ans. = \frac{22\frac{1}{2} \times 18}{40\frac{1}{2}} = \frac{\overset{5}{\cancel{45}} \times \overset{2}{\cancel{18}} \times \cancel{2}}{\cancel{2} \times \cancel{81}_{9}} = 10 \text{ days.}$$

LXVI. Examination Papers.

1) The ratio of 1 mile travelled on each is $\frac{18}{405} : \frac{9\frac{1}{2}\frac{1}{4}}{1760}$;

that is, $\frac{2}{45} : \frac{\cancel{2}\cancel{3}\cancel{0}}{\cancel{2}\cancel{7}\cancel{6}\cancel{0}_{12}} = 24 : 45$ or $8 : 15$

3) First income $= \frac{£2000 \times 3}{98\frac{5}{8}} = £60\ 16s.\ 8\tfrac{8}{26}\tfrac{0}{3}\tfrac{0}{3}d.$

Second „ $= \frac{£2000 \times 4\frac{1}{4}}{93\frac{3}{4}} = £90\ 13s.\ 4d.$

$\therefore$ Decrease of income $= £90\ 13s.\ 4d. - £60\ 16s.\ 8\tfrac{8}{26}\tfrac{0}{3}\tfrac{0}{3}d.$
$= £29\ 16s.\ 7\tfrac{63}{263}d.$

(10) Interest on £100 for 52 days at $2\frac{1}{2}$ per cent. *per an*
$= 130d. = 10s.\ 10d.$

$\therefore$ £100 10*s.* 10*d.*; £512 15*s.* 3*d.* :: 10*s.* 10*d.*
: £2 15*s.* 3*d.* *Ans.*

(11) $\left.\begin{matrix} 1 : 4 \\ \frac{1}{3} : 1 \\ 3 : 2 \end{matrix}\right\}$ :: 5 men : required number

$\therefore$ Required number $= \dfrac{4 \times 5 \times 2 \times 5}{3} = 66\frac{2}{3}$

(12) Required time $= \dfrac{10 \times 1760 \times 7 \times 1\frac{2}{3}}{800 \times 15} = 17\frac{1}{9}$ days.

(14) Time by first vessel $= 74 \div 9\frac{1}{4} = 8$ hours.

$\therefore$ it arrives at 4 P.M.

Time by second $= \dfrac{5 \times 8}{8} = 5$ hours.

Now 3 hrs. 55′ P.M $-$ 5 hrs. $=$ 10 hrs. 55′ A.M. *Ans.*

(15) Soldiers and navvies do $\frac{1}{4}$ in 1 day.

Soldiers and $\frac{1}{2}$ navvies $\frac{1}{7}$ „ „

$\therefore \frac{1}{2}$ navvies do in 1 day $\frac{1}{4} - \frac{1}{7} = \frac{3}{28}$, and all the nav
$\frac{3}{28} \times 2 = \frac{3}{14}$

Soldiers do $\frac{1}{4} - \frac{3}{14} = \frac{1}{28}$ in a day, and $\frac{4}{28} = \frac{1}{7}$ i
days, the *Ans.*

LXVII. Miscellaneous Questions.

1) 2) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
2) 7, 4, 9, 5, 11, 6
$7 \times 4 \times 3 \times 5 \times 11 \times 2 \times 3 \times 2 = 27720$ L.C.M.

2) $$\frac{4\frac{1}{2} - 3\frac{1}{3} + 5\frac{5}{12}}{7\frac{1}{2} - 4\frac{1}{3} + 11\frac{1}{2}} - \frac{11\frac{3}{4} - 5\frac{7}{15}}{11\frac{3}{4} + 5\frac{7}{15}} = \frac{\frac{54-40+61}{12}}{\frac{90-52+133}{12}} - \frac{\frac{705-328}{60}}{\frac{705+320}{60}}$$

$$= \frac{25}{171} - \frac{377}{1033} = \frac{4336}{58881} \quad \textit{Ans.}$$
57

4) $$\frac{1}{\sqrt{2}} = \frac{1 \times \sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{\sqrt{2}}{2} = \frac{1{\cdot}41421}{2} = {\cdot}707106\ldots \quad \textit{Ans.}$$

7) The *second* waggon goes as far while the man is going 40 yards as both have gone when he was going first 20 yards, because both travel at a uniform rate. It is plain when first is met second must be midway in remaining distance: consequently both have gone 20 yards while the man was going 20; consequently he goes twice as fast.

8) £3 17*s*. $10\frac{1}{2}$*d*. : £1 } :: 1 oz. : = 5 dwts. $144\frac{2}{7}\frac{9}{0}\frac{3}{3}\frac{4}{5}\frac{5}{0}$ grs.
113 : 123 }

9) $\sqrt{\frac{1}{9}\frac{2}{9}\frac{3}{9}\frac{4}{9}\frac{5}{9}\frac{6}{9}\frac{7}{9}\frac{9}{9}} = \sqrt{\frac{0}{81}} = \frac{1}{9} = {\cdot}1$

(13) $\frac{2}{9} \times \frac{2}{9} = \frac{4}{81} = \cdot 049382716$ $\quad \sqrt{\frac{625}{900}} = \sqrt{\frac{25}{36}} = \frac{5}{6} = \cdot 8\dot{3}$

(14) If £100 be the cost of a cable:

First year's net receipts = $\frac{5}{6}$ of (18 per cent.—£600) = 15 per cent.—£500

Second year's net receipts = 37 per cent.—2(£600+3 cent.—100) = 37 per cent.—6 per cent.—£1000 = 31 cent.—£1000 = £14500

$\therefore$ 31 per cent. = £15500, and cost of cable = $\frac{15500 \times}{31}$ = £50,000

and net receipts = 500 × 15—500 = £70000. *Ans.*

(15) £10 10*s.* : £100 : : £1 1*s.* : 10 per cent.

(16) See XXX. Ex. 1.

(17) $$Ans. = \frac{875}{24 \times 60 \times 60} = \frac{2 \cdot 1875}{\cancel{24} \times 6 \times 6} = \frac{\cdot 364583}{6 \times 6}$$

$$= \frac{\cdot 060763\dot{8}}{6} = \cdot 0101273\dot{1}4\dot{8}$$

(18) Quantity remaining after leakage is deducted

$$= 46\tfrac{1}{2} \text{ galls} = \frac{46\frac{1}{2} \times 9}{12} = \frac{279}{8} \text{doz.}$$

$$\therefore Ans. = \frac{(£37\ 4s. \times 115)}{100} \div \frac{279}{8}$$

$$= \frac{744s. \times 115 \times 8}{100 \times 279} = 24s.\ 6\tfrac{2}{5}d.$$

(19) See LVIII. (93). (20) See XXIV. Ex. 6.

(21) Since the increase and decrease per cent. are equal, the cost of the quantities of both wines are equal.

$\therefore$ galls. of cheaper: galls. of dearer :: prime cost of dearer : prime cost of cheaper: hence *Ans.*

(22) $87{\cdot}45 - 15{\cdot}9 = 71{\cdot}55$ increase per cent. of lead

$\therefore$ $87{\cdot}45 : 71{\cdot}55 :: 216\frac{1}{4}$ cwt. : *Ans.*

$$\therefore \textit{Ans.} = \frac{7155 \times 865}{8745 \times 4} = 176 \text{ tons } 18 \text{ cwt. } 2 \text{ qrs. } 15\tfrac{5}{11} \text{ lbs.}$$

(23) £3 : £68 3*s.* 6*d.* :: £93½ : required amount

$$\therefore \text{Required amount} = \frac{187 \times \overset{2727}{\cancel{1}\cancel{0}\cancel{0}\cancel{0}\cancel{2}}}{\cancel{2} \times \cancel{3} \times 240} = £2124 \ 15s. \ 9d.$$

(24) *Ans.* = $\frac{1}{12}$ of 3 oz. 5 dwts. = 5 dwts. 10 grs.

(25), (26), and (27), are Elementary.

(28) £18 8*s.* $\div \dfrac{£4600 \times 1\frac{1}{2}d.}{100} = 4416 \div 696 = 64$ days.

(29) See XXX. Ex. 1. (30) See XLI. Exs.

(31) Required weight $= \dfrac{4 \text{ oz.} \times 20}{5{\cdot}136 \text{ dwts.}} \div \dfrac{1 \text{ lb.}}{66} = \dfrac{80 \times 20}{5{\cdot}136 \times 66}$

$= 4$ lbs. 8 oz. 12 dwts. $19\frac{901}{1177}$ grs.

(32) See XXX. Ex. 1. (33) See XXVI. (22).

34), (35), (36), (37), and (38), are similar to many worked out above.

(39) $3\frac{1}{2}d.$: £100 :: $42d.$: *Ans.*
$33\frac{1}{3}$ yrs. : 1 yr.

$$\therefore \textit{Ans.} = \frac{\cancel{100} \times \cancel{42} \times 2 \times 3}{\cancel{7} \times \cancel{100}} = 36$$

(40) (i) $\textit{Ans.} = \frac{3}{100}$ (ii) $\textit{Ans.} = \dfrac{£3 - 2s.\ 3d.}{£100} = \dfrac{£2\ 17s.\ 9d.}{100} = \dfrac{231}{8000}$

(41) (1 oz. $\times \frac{5}{6}$) : (10 lbs. $\times \frac{525}{900}$) :: £3 17*s.* 6*d.* : required price

$$\therefore \text{Required price} = \frac{\cancel{10} \times \cancel{12} \times \cancel{525} \times \cancel{6} \times 31}{\cancel{5} \times \cancel{900} \times \cancel{8}} = £325\ 10s.$$

(42) $A + B$ can do $\frac{1}{4}$ in one day, $B + C$ can do $\frac{1}{6}$ in a day, and $A + C$ $\frac{1}{8}$ in a day ; $\therefore 2A + 2B + 2C$ can do $\frac{1}{4} + \frac{1}{6} + \frac{1}{8} = \frac{13}{24}$ in a day, and $A + B + C$ will do $\frac{13}{24} \div 2 = \frac{13}{48}$

$$\therefore \textit{Ans.} = 48 \div 13 = 3\tfrac{9}{13} \text{ days.}$$

(43) 10 of first set in 1 hr. do. $\frac{12}{16} = \frac{3}{4}$ of a load
12 of second set in 1 hr. do. $\frac{9}{15} = \frac{3}{5}$ „
$\therefore$ both in 1 hr. do $\frac{3}{4} + \frac{3}{5} = \frac{27}{20}$ „
$\therefore \textit{Ans.} = 100 \div \frac{27}{20} = \frac{2000}{27} = 74\frac{2}{27}$ hrs.
Again, 1 man of first will do $\frac{3}{40}$ of a load
$\therefore$ 100 loads in $\frac{4000}{3} = 1333\frac{1}{3}$ hrs. ; and so on.

(44) Area of court-yard = £38 10*s.* 5*d.* $\div$ 3*s.* 9*d.* = 9245 $\div$ 45 $= \frac{1849}{9}$ sq. yds.
$\therefore$ Required side = $\sqrt{\frac{1849}{9}} = \frac{43}{3} = 14$ yds. 1 ft.

Since 3 horses=50 sheep

21 „ *and* 217 sheep=567 sheep.

and 9 „ and 60 „ =210 „

$\left.\begin{matrix}\therefore 567:210\\ 10:27\end{matrix}\right\}$ ::£56 8*s.* 4*d.*:£56 8*s.* 4*d. Ans.*

Hand Labour.		*Machine.*	
	£5000		£4000
of £5000 − 300 =	200	$\frac{1}{5}$ of £4000—300 =	500
	5200		4500
of £5200 − 300 =	220	$\frac{1}{5}$ of £4500—300 =	600
	5420		5100
of £5420—300 =	242	$\frac{1}{5}$ of £5100 − 300 =	720
	5662		5820
of £5662—300 =	266·2	$\frac{1}{5}$ of £5820—300 =	864
	5928·2		6684
£5928·2 − 300 =	292·82	$\frac{1}{5}$ of £6684—300 =	1036·8
from hand labour	£6221·02	Total from machine	£7720·8

∴ £7720·08 − £6221·02 = £1499 15*s.* 7·2*d. Ans.*

Here $3 + 4\frac{1}{5} + 5\frac{2}{5}$ + &c. = 171

Multipy by 5, and 15 + 21 + 27 + &c. =855

Divide by 3, and 5 + 7 + 9 + &c. =285

Add first-two terms, & 1 + 3 + 5 + 7 + &c. = 289

Now $\sqrt{289}$=17, and taking away the two terms just added we have *Ans.*=15.

Income=(£52 10*s.* − £18 15*s.*)÷9 = 8100÷9 = £900

First tax = £18 15*s.* ÷ 900=4500*d.*÷900=5*d.*

Putting 15 per cent. on 28*s.* and 20 per cent. on 42*s.* we have (see *Alligaton.*)

Selling price of wine $32\frac{1}{5}$ } 35*s.* { $15\frac{2}{5}$

„ „ brandy $50\frac{1}{5}$ } { $2\frac{1}{5}$

∴ *Ans.*=$15\frac{2}{5}:2\frac{1}{5}$=77:14=11:2.

See XIV. (128).

(51) Required income $= \frac{£862\ 10s. \times 240}{230} = £900$

(52) $\left.\begin{matrix} 60 : 95 \\ 1 : 25 \end{matrix}\right\}$ :: £6000 : amount in *francs*

$\therefore$ French stock $= \frac{6000 \times 95 \times 25}{60} = 237500$ *francs*.

LXVIII.

(1) (i.) $Ans. = \frac{39{\cdot}371 \times 1000}{1760 \times 36} = \frac{3937{\cdot}1}{176 \times 36} = \frac{492{\cdot}1375}{22 \times 36}$

$= \frac{61{\cdot}5171875}{11 \times 9} = 6{\cdot}83524305 \div 11 = {\cdot}621385732$

(ii.) $Ans. = \frac{36}{39{\cdot}371} = {\cdot}914378$

(2) $Ans. = \frac{150 \times 11960{\cdot}3326}{4840} = 370$ ac. 2 r. 27·49 poles.

(3) $12{\cdot}37 \times 7{\cdot}14 \times {\cdot}83 \times 2\frac{1}{2} = 183{\cdot}267735$ solid metres

$\therefore$ *Ans.* = 183267·735

(4) $Ans. = \frac{25{\cdot}34 \times 18{\cdot}36 \times (39{\cdot}371)^2 \times 4\frac{1}{2}}{(36)^2 \times 20}$ £

$= \frac{1{\cdot}93851 \quad 7{\cdot}75404 \times (39{\cdot}371)^2 \times 9}{2 \times 36 \times 36 \times 20} = \frac{{\cdot}08077125 \quad {\cdot}48462775 \times (39{\cdot}371)^2}{4 \times 6}$

$= {\cdot}08077125 \times 1550{\cdot}075641 = 125{\cdot}201547118125$

$= £125\ 4s.\ 0{\cdot}3713083491d.$

$39{\cdot}371 \times 32$ should be nearly 36×35

i.e. $39{\cdot}371 \times 8$ nearly $= 9 \times 35$

i.e. $314{\cdot}968 = 315$ **nearly,** the difference being only ·032

Again $\dfrac{40000000 \times 39{\cdot}371}{1760 \times 36} = \dfrac{19685500}{8 \times 11 \times 9} = \dfrac{2460687{\cdot}5}{11 \times 9}$

$$= \frac{223698{\cdot}8\dot{6}\dot{3}}{9} = 24855{\cdot}4\dot{2}\dot{9}$$

$$\text{Price of silk in pounds} = \frac{34{\cdot}45 \times 39{\cdot}37 \times 27 \times 4}{39{\cdot}37 \times 39{\cdot}37 \times 25{\cdot}15} \quad \begin{matrix}9\\5{\cdot}03\end{matrix}$$

„ 1 yd. cotton„ $= \dfrac{4 \times 3 \times 3}{240}$

$$\therefore \textit{Ans.} = \frac{34{\cdot}45 \times 9 \times 4 \times 4}{39{\cdot}37 \times 5{\cdot}03} = \frac{496080}{1980311} = 25\tfrac{100225}{1980311} \text{ yds.}$$

') Cost of Frenchman's coffee above Englishman's in pence

$$= \frac{(1160 - 473) \times {\cdot}56438 \text{ drs.} \times 20d.}{16 \times 16} = \frac{387{\cdot}72906 \times 20}{16 \times 16} \quad \begin{matrix}5\\4\end{matrix}$$

$$= \frac{1938{\cdot}6453d.}{64}$$

Again, cost of Englishman's tea above Frenchman's

$$= \frac{(1679 - 9) \times {\cdot}56438 \text{ drs.} \times 36d.}{16 \times 16} = \frac{942{\cdot}5146 \times 36}{16 \times 16} \quad \begin{matrix}9\\4\end{matrix}$$

$$= \frac{8482{\cdot}6314d.}{64}$$

$$\therefore \textit{Ans.} = \frac{8482{\cdot}6314 - 1938{\cdot}6453}{64 \times 10\frac{1}{2}} = \frac{623{\cdot}2369\dot{1}\dot{9}}{64}$$

$= 9fr.{\cdot}73807\ldots$

LXIX.

(1) See N (1). (2) See N (2).

(3) 30·15 chains=663·3 yards, and 3 fur. 6 rds.=693 yds.

$$\therefore Ans. = 693 - 663{\cdot}3 = 29{\cdot}7 \text{ yards.}$$

(4) See "Discount." (5) See XXXIX.

(6) Area of room=(27 ft. 8 in. +21 ft. 4 in)$\times 2 \times 12 = 1176$ sq

$$\therefore Ans. = \left(\frac{1176}{9} \div \frac{12 \times 3}{4}\right) \times 4\tfrac{1}{2}s. = £3\ 5s.\ 4d.$$

(7) Multiply the area by 2, then 7 ac. = 43908480
$\sqrt{43908480} = 6644$ in.=184 yds. 1 ft. 8 in.

(8) See *Arithmetic*, p. 131.

(9) First income=int. on £5250 at $6\frac{1}{2}$ *p.c.*=£406 5*s.* t
state as in XXXVIII., Ex. 6. [I am of opinion t
$185\frac{5}{6}$ should be $185\frac{5}{8}$. The *Ans.* would then be £31

(10) See O (4). (11) See P (7).

(12) It loses 3′ 10″ a day, or $7\frac{1}{12}$ secs. an hour; and since fi
12 o'clock on Monday to $10\frac{1}{4}$ on Sunday=$142\frac{1}{4}$ hrs.
watch will lose $142\frac{1}{4} \times 7\frac{1}{12}$ secs.=$1126\frac{7}{48}$ secs.=18
$46\frac{7}{48}$ secs.

$$\therefore Ans. = 8 \text{ m. } 46\tfrac{7}{48} \text{ secs. past ten.}$$

(13) See LII. (37).

(14) See N (7), XLII. (7), and recollect $\dot{9} = 1$.

(15) See pp. 246-7 in Arithmetic.

LXX.

(1) ·05735 of a mile=100·936 yds. $\therefore$ *Ans.* $=(100{\cdot}93646+25)\div 1540$.

(2) See LVII. (4).

(3) By *Chain Rule Ans.* in £'s$=\dfrac{10\times 2\times 21\times 42\times 5}{20\times 3\times 20\times 4}$

$$=\frac{294}{25}\text{£}=\text{£}11\ 15s\ 2\tfrac{2}{5}d.$$

(4) $$Ans.=\frac{\overset{40}{\cancel{20}}\times\overset{3}{\cancel{18}}\times 25}{\underset{4}{\cancel{18}\times\cancel{24}}}=750$$

(5) *Ans.*$=154\div(1\frac{1}{2}+1\frac{1}{4})=56$ hrs.

(6) See XXVIII. (*a*). (7) See X. (7).

(8) See XLII. (7). (9) See LII. (27).

(10) *Ans.* $=\sqrt{6^2+8^2}=10$.

(11) As the pressure is uniform

$$Ans.=\sqrt{\frac{6\times 6\times 6}{5\frac{3}{8}}}=\sqrt{\frac{1728}{43}}$$

$$\frac{74304}{43\times 43}=\frac{272{\cdot}587}{43}=6{\cdot}339$$

(12) See *Arithmetic*, p. 209, Ex. 1.

(13) If we take $\frac{5}{6}$ of the cost, we have the cost of a square on the shorter side; then reduce to pence, divide by 5, and take the square root.

(14) Amount of £1 for 3 years at $5 = 1{\cdot}05 \times 1{\cdot}05 \times 1$
$= 1{\cdot}157625$, which divide into £144·703125 for the *A*.

(15) $Ans. = [(1538\frac{2}{3} \times {\cdot}45) - (60 \times 11{\cdot}324)] \div 54$
$= (692{\cdot}4 - 679{\cdot}44) \div 54 = 12{\cdot}96 \div 54 = {\cdot}24$

LXXI.

(1) (*a*) $\sqrt{\cdot 0003418801} = {\cdot}01849$

(*b*) Reduce $\frac{1}{4}$ to a decimal, then take root of ·250,000,0(&c.

(2) 3) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,
2) 8, 3, 10, 11, 4, 13, 14, 5
4, 3, 5, 11, 13, 7

$Ans. = 4 \times 3 \times 5 \times 11 \times 13 \times 7 \times 2 \times 3 = 360360$

(3) $7 \times 22 = 154$
$12\frac{1}{2} \times 21 = 262\frac{1}{2}$
$17 \times 19 = 323$
$739\frac{1}{2}$; now $739\frac{1}{2} \div 36\frac{1}{2} = 20\frac{19}{73}$ *Ans.*

(4) $27 : 15 :: 4500 : 3250$
$10 : 13 ::$
$\therefore 4500 - 3250 = 1250.$ *Ans.*

(5) $Ans. = \dfrac{-5\frac{1}{3}}{-\frac{1}{2}\frac{1}{4}} \div \dfrac{2\frac{6}{5}}{-\frac{3}{7}\frac{1}{2}} = \dfrac{-16}{3} \times \dfrac{-1}{1} \times \dfrac{5}{26} \times \dfrac{-31}{72}$
3

$= -\dfrac{2480}{78} = -31\frac{31}{39}.$

Again, $2 + \dfrac{1}{1 + \dfrac{1}{2 + \dfrac{1}{2 + \frac{1}{2}}}} = 2 + \dfrac{1}{1 + \dfrac{1}{2 + \frac{5}{2}}} = \dfrac{1}{2\frac{5}{12}} = \dfrac{12}{29}$

(6) As $115\frac{3}{4} : 100 :: £694\ 10s. : £600$. *Ans.*

(7)
$$\begin{array}{r} Ans. = 5 \text{ qrs.} \\ \frac{5}{12\times 8} = 1\frac{3}{5} \text{ yds.} \\ 12 = 4\frac{1}{2} \text{ dols.} \\ 1 = 50d. \end{array}$$

$$\therefore \frac{\cancel{5}\times 8\times 9\times \cancel{50}\times \cancel{12}\times \cancel{8}}{\cancel{12}\times \cancel{5}\times \cancel{2}\times \cancel{240}\times \cancel{5}} = £12$$
$$\cancel{48}$$
$$6$$

(8)

Statement.	
96 : 160	
8 : 11	
230 : 220	
11 : 7	} 6 days : x
3 : 2	
5 : 7	
5 : 4	

(9) $23\times 27 = 621$
$21\times 39 = 819$

$$\cancel{1440} : 621 :: \cancel{54}\ 3$$
$$80)\ 3$$
$$1863$$
$$\begin{array}{l} £23\ \ 5s.\ 9d.\ A \\ £30\ 14s.\ 3d.\ B \end{array} \Big\} Ans.$$

(10) Elementary.

(11) $\frac{1}{7}-\frac{1}{13}=\frac{6}{91}=$ A's rate; $\frac{1}{13}\times\frac{3}{1}=\frac{3}{13}$; $\therefore \frac{10}{13}$ to be done:

$$\text{now } \frac{10}{13}\div\frac{6}{91} = 8\tfrac{2}{3} \text{ days.}$$

(12)
30 fathoms @ £5 = 150
30 „ @ £25 = 750
} £900 cost of 60 fathoms.

1 part @ 20 = 20
3 parts @ 35 = 105
4 parts @ 25 = 100
} £225 cost of 8 fathoms in given proportion.

Consequently, $\frac{1800 \times 8}{225} = 64$

Now, $64 + 60 = 124$ *Ans.*

(13) Distance between A and $B = 200$ yards. He will overtake him in $\frac{200 \times 16}{3} = 1066\frac{2}{3}$ yards.

Now B goes twice and A thrice round.

(14) Interest on Honds. and Turks $= £180 \times 2 + £135 \times 3 = £765$. Again, loss on Honds. $= 18 \times 20 = £360$. Gain on Turks $= £27$; $\therefore$ Net gain $= £765 + £27 - £360 = £432$; as on each Spanish bond he gained £7.

$$\therefore \textit{Ans.} \frac{£1146 - £432}{7} = 102$$

(15) They had at the end of 3rd year £33,327 ; at end of 2nd $\frac{£33,327 \times 100}{105}$; at end of 1st $\frac{£33,327 \times 100 \times 100}{105 \times 103\frac{1}{2}}$ $= £30,666\ 13s.\ 4d.$, the original capital, which divide in ratio of 2 : 3 for *Ans.*

LXXII.

(1) to (23) are very elementary.

(24) 1 lb. $= 1s.$; $\therefore \frac{3}{4}$ lb. or 12 oz. $= 9d.$

$$\therefore \textit{Ans.} = \frac{6 \times 8 \times 4}{9} = 21s.\ 4d.$$

(25) See N (2). (26) See Ex. 2, page 193 in *Arithmdu*

27) A does $\frac{1}{3}$. B $\frac{1}{4}$, and C $\frac{1}{5}$ in a day; together they can do

$\frac{1}{3}+\frac{1}{4}+\frac{1}{5}=\frac{47}{60}$ $\therefore Ans.=1\frac{13}{47}$, each doing $\frac{20,\ 12,\ 15}{47}$

spectively.

28) See LVIII. (93).

29) Since 3 acres=130680 sq. ft.,

cubic feet of ice=130680÷2=65340

$\therefore Ans.=65340\times 896\div 2240\times 16$

$=3267\times 4\div 8=1633\frac{1}{2}$ tons.

30)

	·00,43,04,67,21
	36
125	704 (·06561 *Ans.*)
	625
1305	7967
	7836
13121	13121
	13121
$300\times 9=2700$	40·353,607
$30\times 3\times 4=\ 360$	27
$4^2=\ 16$	13353 (3·43 *Ans.*)
3076	12304
16	1049607
346000	1049607
$30\times 34\times 3=\ 3060$	
$3^2=\ 9$	
349869	

31) See L (12).

LXXIII.

) 16 men in 8 days will earn £12 16*s.*; consequently 12 boys will earn £23 4*s.* – £12 16*s.* in 8 days=£10 8*s.*, or £1 6*s.* in one day, or 2*s.* 2*d.* a day: whence find the *Ans.*

(2) See LXVIII. (30). (3) See XXXVIII. (38).

(4) This question refers to the ordinary British school, at which the pupils attend morning and evening; hence they make, exclusive of Saturday, 10 attendances in the week.

(5) With a unit of the goods he mixes $\frac{1}{4}$, which is only worth $\frac{1}{5}$, and on $1\frac{1}{5}$ he gains $\frac{1}{10}$ of $1\frac{1}{4}+\frac{1}{20}=\frac{5}{40}+\frac{1}{20}=\frac{7}{40}$

$$\therefore \text{gain per cent.} = 100\times\tfrac{7}{40}\div 1\tfrac{1}{5}$$

$$= 10\not{0}\times 7\times 5\div 4\not{0}\times 6 = 350\div 24 = 14\tfrac{7}{12}$$

To gain 20 *p.c.* or $\frac{1}{5}$ he must mix an article on which he gains $\frac{1}{10}$ with one on which he gains $\frac{3}{8}$: thus

$$1\tfrac{1}{10} > 1\tfrac{1}{5} < \tfrac{7}{4}$$
$$1\tfrac{3}{8}$$

$$\therefore 7:4 \textit{ Ans.} \text{ or by weight } 7:5$$

(6) 10 days' work of A+2 of B=2 of A + 8 of B; $\therefore$ 8 of A=6 of B or 1 of A=$\frac{3}{4}$ of B; $\therefore$ 10 of A + 2 of B=$9\frac{1}{2}$ of B, or = $12\frac{2}{3}$ of A.

$$\therefore \textit{Ans.} = 1\div(\tfrac{3}{8}+\tfrac{2}{19}) = 5\tfrac{3}{7}$$

(7) If he had £90: then $\frac{1}{3}$ of it brings an income of £1 in 3 per cents; $\frac{1}{4}$ of it will give $18\times 4\div 100=\cdot 72$; $\frac{1}{4}$ of it $(90\div 4)\times 4\frac{1}{4}\div 100=\cdot 95625$; remainder=£19 10*s.* will give $19\cdot 5\times 5\div 104=\cdot 9375$.

Now $1+\cdot 72+\cdot 95625+\cdot 9375=£3\cdot 61375$ income.

$$\therefore \textit{Ans.} = 481\cdot\dot{8}\dot{3}\times 90\div 3\cdot 61375 = £12{,}000$$

(8) By rail he could do it in 2 hours, consequently the train goes 30 miles an hour. But 1 hour=$\frac{2}{5}$ time on coach. $\therefore$ *time* on coach=$2\frac{1}{2}$ hours, and on train $\frac{1}{2}$ an hour or *15 miles*. It is obvious he went 45 by coach.

(9) Here $\cdot 3 - \cdot 225 = \frac{075}{1000} = \frac{3}{40}$ From the question $\cdot 31$ of the number $= \cdot 225$ of the number $+ \cdot 225$ of 400: or $\frac{3}{10} - \frac{9}{40} = \frac{3}{40}$ of the number $= 90$

$$\therefore \textit{Ans.} = 90 \times 40 \div 3 = 1200$$

(10) The 3 per cents will only represent $\frac{2}{3}\frac{0}{0}$ of the 5 millions. $\therefore \frac{1}{20}$ of 5,000,000 or 250,000 must be represented by the $3\frac{1}{4}$ per cent. stock. Now the price of the $3\frac{1}{4}$

$$= 94 \times 3\tfrac{1}{4} \div 3 = \frac{1235}{12}$$

$$\therefore \textit{Ans.} = 250{,}000 \times 100 \div \frac{1235}{12}$$

$$= 60{,}000{,}000 \div 247 = 242{,}914\tfrac{2}{3}\tfrac{2}{4}\tfrac{2}{7}$$

(11) While the passenger was going 60, the goods train at $\frac{2}{3}$ of its speed did 40; consequently in the hour before the passenger started the latter did 20 miles.

(12) Elementary.

(13) *Ans.* = area of room in inches $\div$ area of a stamp $= (854 \times 126) \div \frac{1}{2} \times \frac{2}{5} = 854 \times 126 \times 5 = 538020$

LXXIV.

(1) Since $121 = 11 \times 11$, having multiplied in the first instance by 11 in one line, we then multiply by 7 for second line, and take 11 times the first for the third line, duly "falling back."

(2) On reducing both quantities to seconds, the G.C.M. is found 1235477 secs. = 14 days 7 hrs. 11′ 17″; now one quantity is 11 times, the other 17 times this; $\therefore$ L.C.M. = 14 *days* 7 *hrs.* 11′ 17″ $\times 11 \times 17 = 2674$ days 9′ 59″.

(3) $$Ans. = \frac{11}{6} \times \frac{1\frac{5}{6}}{3\frac{5}{12}} \times \frac{5}{2} \times \frac{7}{22} + \frac{3}{\cancel{12}_{2}} \times \frac{\cancel{8}}{11} \div \frac{\cancel{9}}{1} \times \frac{2}{\cancel{9}_{3}} + \frac{\cancel{3}}{\cancel{9}_{2}} \times \frac{1}{\cancel{3}}$$

$$= \frac{11}{6} \times \frac{11}{6} \times \frac{12}{41} \times \left(\frac{35}{44} + \frac{3}{22}\right) \div \left(\frac{2}{3} + \frac{3}{2}\right)$$

$$= \frac{11}{\cancel{6}_{2}} \times \frac{\cancel{11}}{\cancel{6}} \times \frac{\cancel{2}}{\cancel{12}_{\cancel{41}}} \times \frac{\cancel{41}}{\cancel{44}_{4}} \times \frac{\cancel{3}}{\cancel{6}} \div \frac{}{13} = \frac{11}{26}$$

(4) $$5000s. \text{ weigh} = \frac{5000}{5s.\ 2\frac{1}{2}d.} = 960 \text{ oz.}$$

$$1 \text{ sov. weighs } \frac{20s.}{£3\ 17s.\ 10\frac{1}{2}d.} = \frac{480}{1869} \text{ oz.}$$

$$\therefore Ans. = 960 \div 480 \times 1869 = 3738 \ Ans.$$

(5) If the bullet and sound passed spectator at same instant spectator would hear the shot strike in 2″; hence the bullet was $\frac{1}{2}$″ behind the sound; consequently in the whole distance it was 1″ behind the sound, *i.e.* the sound went 550 yds. in $1\frac{1}{2}$″; $\therefore$ *Ans.* in feet $= \frac{550 \times 3}{1\frac{1}{2}} = 1100$ per second.

(6) $$Ans. = 8\frac{1}{15} \div \frac{19}{105} = \frac{121}{15} \times \frac{105}{19} = \frac{847}{19}$$

$$= 44\cdot\dot{5}78947368421052631\dot{}$$

(7) Reduce to sq. yds. and take $\surd$ which gives 4374.

(8) Multiply in usual way.—See Ex. p. 132 in *Arithmetic.*

(9) Reduce to inches, and take $\sqrt[3]{}$, which gives 34 ft. 6 in.

(10) Cost of shares = £200; selling price = 45 + 41 + 37 + 33 + 29 = 185 : $\therefore$ interest = £200 − 185 = £15 on 5 shares for a year, 4 for a year, and so on, being 15 shares for 1 year, *i.e.* £1 per share.

(11) Since 5 per cent. $= \frac{1}{20}$. Buying at 5 per cent. less is buying at $\frac{19}{20}$; hence we have

$\frac{19}{20}$ price : ($\frac{21}{20}$ price − 1*s.*) :: 100 : 110

Multiplying extremes and means—see *Arithmetic*, p. 135.

$$\frac{21}{20} \text{ price} \times 100 - 100s. = \frac{19}{20} \text{ price} \times 110$$

$$\text{or } 105 \text{ price} - 100s. = 104\tfrac{1}{2} \text{ price}$$

$$\therefore \tfrac{1}{2} \text{ price} = 100s. \quad \therefore Ans. = 200s. = £10$$

2) Income from $3\frac{1}{2}$ per cents. $= £150 + 5 = £155$

$$\therefore \text{Cash for which the stock was sold} = 155 \times 87\tfrac{1}{2}$$

$$Ans. = \frac{\overset{31}{\cancel{155}} \times 87\frac{1}{2} \times \overset{1}{\cancel{100}}}{3\frac{1}{2} \times \underset{10}{\cancel{500}}} = \frac{31 \times 175}{70} = \frac{5425}{70} = 77\tfrac{1}{2}$$

3) Since 2 men and 5 boys do $\frac{1}{4}$ in 3 days, 1 man and 1 boy, who assisted them in doing $\frac{1}{3}$, do $\frac{1}{3} - \frac{1}{4} = \frac{1}{12}$ in 3 days. Consequently 5 men and 5 boys could do $\frac{5}{12}$; but 2 men and 5 boys do $\frac{1}{4}$; $\therefore$ 3 men in 3 days can do $\frac{5}{12} - \frac{1}{4} = \frac{1}{6}$, or $\frac{1}{18}$ in 1 day.

$$\therefore 1 \text{ man} = \tfrac{1}{54} \text{ in 1 day.}$$

Work to be done $= 1 - \left(\frac{1}{9} + \frac{1}{2} + \frac{1}{3}\right) = \frac{1}{18}$ by the additional men; $\therefore \frac{1}{18} \div \frac{1}{54} = 3$ men. *Ans.*

4) Time by $A = \frac{\overset{22}{\cancel{1760}} \times \overset{6}{\cancel{36}}}{270 \times \underset{\not{6}}{\cancel{48}}} = \frac{\overset{44}{\cancel{132}}}{\underset{9}{\cancel{27}}} = 4\frac{8}{9}$ minutes.

Time by $B = \frac{(1760 \times 36) - (300 \times 44 \times 4)}{320 \times 44} + 4 = 4\frac{5}{44}$ minutes.

$\therefore$ B wins by $\frac{8}{9} - \frac{3}{4} = \frac{5}{36}$ of a minute, and by the distance

A travels in this time, viz., $\frac{\overset{10}{\cancel{90}}}{\underset{5}{\cancel{270}} \times \underset{\not{6}}{\cancel{48}}} \times \frac{\overset{4}{\cancel{5}}}{\underset{4}{\cancel{36}}} = 50$ yards.

APPENDIX II.—A.

(1) Total popⁿ. of the 3 towns in 1851 = $4402{\cdot}6 \times 3 = 13207{\cdot}8$.
Again popⁿ. of first and second in 1851
$$= \frac{112 \times 4235}{100} + \frac{120 \times 2553}{100} = 4743{\cdot}2 + 3063{\cdot}6 = 7806{\cdot}8$$
$\therefore$ popⁿ. of third town in 1851 = $13207{\cdot}8 - 7806{\cdot}8 = 5401$
$\therefore$ Required decrease = $\frac{(6432-5401) \times 100}{6432} = 16\frac{47}{1608}$

(2) See XXXIV. Ex. 5.

(3) Total number of days by both working together = $108 \div 9 = 12$. Therefore the half is done in 6 days, and it requires the son 6 days more to do his own, and $6 \times 1\frac{1}{2} = 9$ days to do as much as his father in 6 days
$$\therefore Ans. = 6 + 9 = 15 \text{ days.}$$

(4) $\left.\begin{array}{l} \frac{£12\ 15s.}{100} \\ \frac{2\frac{1}{2}\ guineas}{12} \end{array}\right\} :: 100 : 100 + \text{percentage profit}$

$$\therefore \text{Required profit} = \frac{100 \times \cancel{5} \times \overset{7}{\cancel{21}} \times 100 \times \cancel{20}}{\underset{4}{\cancel{12}} \times 2 \times \cancel{20} \times \underset{51}{\cancel{255}}} - 100$$

$$= \frac{8750}{51} - 100 = 71\frac{29}{51}$$

(5) 15 ac. 2 rds. 29 pls. 3 yds. = $75900\frac{1}{4}$ yds.
$\therefore$ Required side = $\sqrt{75900\frac{1}{4}} = 275\frac{1}{2}$ yds.

3) C had no loaves, and consequently he had to pay A and B for what they gave him. Each of the three getting $8 \div 3 = 2\frac{2}{3}$, A gave $5—2\frac{2}{3} = 2\frac{1}{3}$, and B $3—2\frac{2}{3} = \frac{1}{3}$

$$\therefore A \text{ gets } \frac{2\frac{1}{3} \times 8d.}{2\frac{2}{3}} = 7d., \text{ and } B \text{ the remainder, } 1d.$$

4) $\left.\begin{matrix} 5\frac{3}{4} : 5 \\ 240 : 230 \end{matrix}\right\}$ :: 100 : required price

$$\therefore \text{ Required price} = \frac{5 \times 230 \times 100 \times 4}{240 \times 23} = 83\frac{1}{3}$$

5) Required profit $= 600 \times 1\frac{1}{2}s. - 104 \times 3\frac{1}{2}s. = 900s.—364s.$
$= £26\ 16s.$

6) See XLI. (4).

7) First average $= (10\frac{1}{2} + 16\frac{1}{4} + 18\frac{1}{6} + 27\frac{1}{3} + 21\frac{1}{4}) \div 4$
$= 93\frac{1}{2} \div 4 = 23\frac{3}{8}$
Second „ $= 93\frac{1}{2} \times 2 \div 9 = 20\frac{7}{9}$

8) £$64\frac{3}{4}$: £$92\frac{1}{2}$ :: 70 *guineas* : 100 + required gain

$$\therefore \text{Required gain} = \frac{185 \times 70 \times 21 \times 4}{2 \times 20 \times 259} — 100 = 105 — 100 = 5$$

9) See XXVIII (*a*).

B.

1) $\frac{4}{11} \times \frac{\overset{5}{\cancel{35}}}{\underset{\cancel{3}}{\cancel{12}}} \times \frac{\overset{2}{\cancel{22}}}{\cancel{7}} \times \overset{7}{\cancel{21}}s. : 4\frac{\overset{4}{\cancel{12}}}{\underset{33}{\cancel{99}}} \times 16\frac{1}{2}s.$

$$= 70 : \frac{\overset{68}{\cancel{136}}}{\cancel{33}} \times \frac{\cancel{33}}{\cancel{2}} := 35 : 34$$

(2) Take half the sum of 2*s.* 6*d.* and 3*s.* 6*d.* for average co

(3) 15*s.* : 16*s.* 6*d.* :: $100 + \frac{7 \times 100}{8}$

$$= \frac{\overset{11}{\cancel{33}} \times \overset{37\frac{1}{2}}{\cancel{187\frac{1}{2}}}}{2 \times \underset{5}{\cancel{15}}} = 206\tfrac{1}{4} \qquad \therefore\ 206\tfrac{1}{4} - 100 = 106\tfrac{1}{4},\ \textit{Ans.}$$

(4) $\left.\begin{array}{lcl} 10 \text{ men} & : & 12 \text{ men} \\ 1 & : & 1\frac{3}{4} \\ 3 & : & 4 \\ 1 & : & 1\frac{1}{2} \\ 1\frac{1}{2} & : & 1 \end{array}\right\}$ :: 25 days : required number of da

$$\text{Therefore } \textit{Ans.} = \frac{\overset{4}{\cancel{12}} \times 7 \times \overset{2}{\cancel{4}} \times \cancel{3} \times \overset{5}{\cancel{25}} \times \cancel{2}}{\underset{2}{\cancel{10}} \times \cancel{4} \times \cancel{3} \times \cancel{2} \times \cancel{3}} = 70$$

(5) Average of each farm = (£3500 + £11200 + £22750) ÷ 3
= £12483 6*s.* 8*d.*

Average price per acre = £37450 ÷ (125 + 400 + 150)
= £55 9*s.* $7\frac{5}{7}$*d.*

(6) 5*d.* : 12*d.* :: £2250000 : required amount

$$\therefore \text{Required amount} = \frac{£5250000 \times 12}{5} = £12600000$$

(7) Average loss per day $= \frac{11 + 8 - 30 \div 7}{3} = 14\frac{5}{7} \div 3$

$$\therefore \text{Loss in 150 days} = 14\tfrac{5}{7}'' \div \cancel{3} \times \overset{50}{\cancel{150}} = 12'\ 15\tfrac{5}{7}''$$

(8) If the breadth be 1, the height is 5, and length 40

$$\therefore \sqrt[3]{\frac{54925}{5 \times 40}} = \sqrt[3]{274{\cdot}625} = 6{\cdot}5 \ \textit{Ans.}$$

(9) $\frac{1\frac{3}{4}}{3\frac{3}{5}} : \frac{1\frac{1}{4}}{2\frac{13}{30}} :: 100 + \text{required distance}$

$$\therefore \text{Required distance} = \frac{5 \times 100 \times \overset{6}{\cancel{30}} \times \cancel{4} \times 18}{\cancel{4} \times 73 \times 7 \times \cancel{5}} - 100 = 5\frac{345}{511}$$

(10) In May 31 days—6 hours = 738 hours,

$\therefore$ in June 1000—738 = 262 hours = 10 days 22 hours

$\therefore$ Required time is 10 P.M.. on 11th June.

(11) 4 tons 12 cwt. 3 qrs. 10 lbs. 7 oz. = 166375 oz.

$\therefore$ Required edge = $\sqrt[3]{\frac{166375}{1000}} = 5{\cdot}5$ feet.

(12) See XV. (13) and (37).

C.

(1) Required decimal = $\frac{29{\cdot}454 \times 20 \times 24}{7000} = \frac{14137{\cdot}92}{7{\cdot}00}$

$= 2019{\cdot}70285714\dot{}$

(2) See XXXV. (2).

(3) $10\frac{\overset{11}{\cancel{9}}}{\underset{11}{\cancel{99}}} \times \frac{\overset{99}{\cancel{60}}\cancel{3}}{\underset{1110}{\cancel{9990}}} \times \frac{2}{\cancel{7}} \times 15s. = \frac{\cancel{111}}{\cancel{11}} \times \frac{\cancel{11}}{\underset{10}{\cancel{1110}}} \times 2 \times 15s. = 3s.$

(4) Loss in duty $= \frac{4500000 \times 4d.}{240} = £75000$

Gain in duty = duty on increase at decreased rate

$$= \frac{4500000}{20} \times \frac{6}{100} \times 8s. = £108000$$

$$\therefore Ans. = £108000 - £75000 = £33000$$

(5) A's share $= \frac{1}{5}$ of £658 17$s.$ = £131 15$s.$ $4\frac{4}{5}d.$

The other shares can be found in the same way

(6) See XXVII. (47). (7) See XXVIII. (a).

(8) 95 : $103\frac{3}{4}$ :: £116 17$s.$: required price

$$\therefore \text{Required price} = \frac{£116\ 17s. \times 415}{95 \times 4} = £127\ 12s.\ 3d.$$

(9) $$\frac{3123 \times 7{\cdot}4}{100} \times \frac{1017 \times 9{\cdot}3}{100} = 231{\cdot}102 + 94{\cdot}581 = 325{\cdot}683$$

$$\therefore \text{Required percentage} = \frac{32568{\cdot}3 \times 100}{5267} = 6{\cdot}183\ldots$$

(10) Gross income $= \frac{£1728 \times 40}{39} = £1772\ 6s.\ 1\frac{11}{13}d.$

(11) Force of stream $= \frac{1}{40}$ in a minute

Force of rowing $= \frac{1}{70} + \frac{1}{40}$ „ „

$$Ans. = \frac{1}{70} + \frac{1}{40} : \frac{1}{40} = 11 : 7$$

(12) It is evident the person will see the other as long as the o train which gains 22 miles an hour is gaining 150 yard (or the length of the shorter) on the other

$$\therefore \text{Required time} = \frac{150 \times 60' \times 60''}{22 \times 1760} = 13\tfrac{3}{22}\tfrac{2}{43}\tfrac{9}{43} \text{ secs.}$$

D.

(1) $\sqrt{459684} = 678$

and $\sqrt{29{\cdot}16 \times 13{\cdot}69} = 19$ yards 2·94 feet.

(2) See LII. (27), page 74 in *Key*.

(3) First income $= \dfrac{£18550 \times 3\frac{1}{2}}{92\frac{3}{4}} = £700$

Second „ $= \dfrac{£18550 \times 4}{5 \times 96} + \dfrac{£18550 \times 4 \times 3}{90 \times 5}$

$= £154\ 11s.\ 8d. + £494\ 13s.\ 4d. = £649\ 5s.\ 0d.$

Therefore alteration $= £700 - £649\ 5s. = £50\ 15s.$

(4) 10 lines : 126·9667 lines :: $\frac{8}{9}$ ft. : required length

$\therefore$ Required length $= \dfrac{126{\cdot}9667 \times 8}{10 \times 9} = 11{\cdot}285928\dot{}$ feet.

(5) and (6). See XXVIII (*a*).

(7) $5s.\ 2d. : 100 :: 4d. :$ required profit

$\therefore$ Required profit $= \dfrac{100 \times 4}{62} = 6\frac{4}{31}$

(8) See XXVIII. (*a*).

(9) Required weight $= \dfrac{539}{£3\ 17s.\ 10\frac{1}{2}d.} \times \frac{12}{11} = \dfrac{539 \times 480 \times 11}{1869 \times 12}$

$= 151\frac{1}{39}$ oz.

(10) $\dfrac{£358{\cdot}3125 \times 2{\cdot}75 \times 2{\cdot}5}{100} = £24\ 6fl.\ 3c.\ 3{\cdot}984375m.$

(11) $37{\cdot}084 \times 13{\cdot}57 = 503{\cdot}22988 = £503\ 4s.\ 7{\cdot}1712d.$ *Ans.*

(12) Number lost $= \frac{729 \times 16}{13\frac{1}{2}} = 864$

Saved by rocket and mortar $= \frac{729 \times 8}{13\frac{1}{2}} = 432$, and so on.

E.

(1) Required number $= \frac{£3296\ 13s.\ 5\frac{1}{4}d. \times 70}{£1025} = 225$

(2) (3). See XXVIII. (*a*),

(4) Present value $= \frac{100 \times £1}{110} = £9\frac{1}{11}$

Proof $\frac{9\frac{1}{11} \times 2 \times 5}{100} = £\frac{10}{11}$

$\therefore £\frac{1}{11} + £\frac{10}{11} = £10.$

(5) Square root $= (1 + 9) \times \frac{9}{2} = 45.$

(6) Required price $= \frac{£25\ 19s.\ 10d.}{7\text{ cwt. }2\text{ qrs. }15\text{ lbs.}} \times \frac{115}{100} = \frac{6238d. \times 11}{885 \times 100}$

$= 8\frac{3337}{8850}d.$

(7) See solution of LII. (37).

(8) Required number $= \frac{25000 \times 1760 \times 3 \times 12\text{ in.}}{66 \times 30\text{ in.}} = 800000$
16 2
6

(9) See XXXVIII. Ex. 8. (10) See LVIII. (12).

11) Multiplying the second by 3 we have :

15 turkeys + 9 fowls = £15 (from)
2 „ + 9 „ = £3 (take)
$\therefore$ 13 turkeys = £12
and 1 turkey = £$\frac{12}{13}$
$\therefore$ 9 fowls = £3 − $\frac{24}{13}$ = 1$\frac{2}{13}$
and 1 fowl = £1$\frac{2}{13}$ ÷ 9 = £$\frac{5}{39}$

12) £2 5*s.* : £11 5*s.* :: 3 feet : required breadth

$\therefore$ Required breadth = $\frac{£225 \times 3}{45}$ = 15 feet.

F.

(1) See XXXIX. Ex. 3. (2) See LVIII. (93).

(3) The square root of three times the square of the edge will give the diagonal

Edge = $\sqrt[3]{37}$ c. ft. 64 in. = $\sqrt[3]{64000}$ = 40 in.

$\therefore$ Diagonal = $\sqrt{3 \times 40^2}$ = $\sqrt{48000}$ = 69·282 in.

(4) Amount of £123 15*s.* in 2 years at 5 p. c. = £136 2*s.* 6*d.*
Present worth of it due 2 yrs. hence „ = 112 10 0
$\therefore$ Required difference = £23 2*s.* 6*d*

(5) Since $C = D + 40$, and $D = B + 60$
$\therefore$ $C = B + 100 = A$.

(6) See LVIII. (240),. (7) See XXVIII(*a*).

$$8)\ 2\frac{\begin{matrix}2\\ 9\,6\,2\\ 2\,8\,8\,6\\ 8\,1\,7\,4\,6\end{matrix}}{9\,9\,9\,9\,9\,9} \times 8\frac{\begin{matrix}8599\\ 8\,1\,8\,1\,6\,3\\ 4\,1\,3\,6\,1\,1\,9\\ 7\,4\,4\,5\,0\,1\,4\,2\end{matrix}}{9\,9\,9\,9\,9\,9\,9\,9\,9} \times \frac{\begin{matrix}63\\ 6\,9\,9\,3\\ 7\,6\,9\,2\,3\\ 9\,9\,9\,9\,9\,9\end{matrix}}{1\,5\,8\,7\,3\,0} = \frac{\begin{matrix}16\\ 6\,4\\ 1\,2\,8\end{matrix}}{6\,3} \times \frac{92599}{10500} \times \frac{\begin{matrix}6\,3\\ 1\,0\end{matrix}}{\begin{matrix}2\,6\,2\,5\\ 5\end{matrix}}$$

$$= \frac{1481584}{13125} = 112{\cdot}8825904761.\ \textit{Ans.}$$

(9) £1 in the 3 per Cents. will give $\frac{3}{87\frac{1}{2}} = \frac{12}{350}$

£1 „ 5 „ „ „ $\frac{5}{131\frac{1}{4}} = \frac{12}{315}$

∴ since $\frac{12}{315}$ is greater than $\frac{12}{350}$, the 5 per Cents. are the better investment.

Difference in £1 invested $= \frac{12}{315} - \frac{12}{350} = \frac{120-108}{3150} = \frac{8}{3150}$

Now $\frac{12}{3150}$: 50 :: £1 : required sum

∴ Required sum $= \frac{50 \times 3150}{12} =$ £13125.

(10) *A* and *B* do $\frac{5}{16}$ in 1 day

A does $\frac{1}{8}$ „

∴ $\frac{5}{16} - \frac{1}{8} = \frac{3}{16}$ what *B* can do in 1 day

∴ Required time $= \frac{16}{3} = 5\frac{1}{3}$ days.

(11) They are at 6 o'clock 30′ apart; and when the minute hand gains 7′ on the hour hand they will be 23′ apart

∴ 11 : 12 :: 7 : $7\frac{7}{11}$ minutes past 6

They will also be 23′ apart when the minute hand gain. 30 + 23 = 53′ on the hour hand

∴ 11 : 12 :: 53 : $57\frac{9}{11}$ minutes past 6.

(12) Of the 3 hours the train was late it lost 2 by slow travelling; and going $\frac{3}{5}$ its speed travels 30 miles while it should travel 50, and goes the difference, 20 miles in 1 hr. 20′ at $\frac{3}{5}$ speed

∴ its reduced rate is $1\frac{1}{3}$: 1 :: 20 miles : 15 miles, which is $= \frac{3}{5}$ its speed

∴ its full speed = 25 miles

Distance travelled to lose 2 hours $= 1\frac{1}{3}$: 2 :: 50 : 75 miles, the distance gone after the accident

∴ Length of line = 75 + 25 = 100 miles.

G.

See C. (10)

Average selling price $=\frac{95\frac{7}{8}+92\frac{5}{8}}{2}=94\frac{1}{4}$ the buying price

∴ he neither loses or gains. (3) See XXVIII. (*a*.)

First percentage gain on 100=30

Second „ „ $130=\frac{130\times 50}{100}=65$

∴ Required gain=65+30=95.

$\left.\begin{matrix}100 \text{ stock}:135 \text{ stock}\\ 3 \quad : \quad 4\frac{1}{2}\end{matrix}\right\}$ :: £$97\frac{1}{8}$: required value

∴ Required value $=\frac{135\times 9\times 777}{100\times 2\times 8\times 3}=$£196 13*s*. $6\frac{3}{4}d$.

See XXXVIII. Ex. 7.

$\frac{180}{10}=18$ days taken by first
$\frac{180}{6}=30$ „ „ second
$\frac{180}{4}=45$ „ „ third

∴ Required time=L.C.M. of 18, 30, and 45=90
First travels $90\times 10=900$ miles
Second „ $90\times 6=540$ „
Third „ $90\times 4=360$ „

Since 5, 6, and 7 are in the same ratio as 50, 60, and 70

$5\times 50=250$
$6\times 60=360$
$7\times 70=490$
Cost of 18 $=1100$

∴ 100 : 120 :: $\frac{100}{18}$: required price

∴ Required price $=\frac{1100\times 120}{100\times 18}=73\frac{1}{3}$*s*.

(9) See LVIII. (84).

(10) $\sqrt{\cdot 047619 \div \cdot 0685714} = \sqrt{(\frac{1}{21} \times \frac{700}{48})} = \sqrt{\frac{100}{144}} = \frac{10}{12} = \cdot 8$

(11) See Rule in Treatise. (12) See Ex. 2, p. 209.

H.

(1) See LVIII. (73) (2) See XXVIII*a*.

(3) 6 sq. ft. 6 in. = 870 sq. in. ; $\therefore$ $870 \times 640 = 556800$ acres

(4) See *Square Root.* (5) See XXXVIII. Ex. 7.

(6) *A* walks 10 miles in $2\frac{2}{3}$ hours

B „ $4 \times 2\frac{2}{3} = 10\frac{2}{3}$ miles in the same time

$\therefore$ $50 - 10 - 10\frac{2}{3} = 29\frac{1}{3}$ still to be travelled

$\therefore$ $(5+4) : 5 :: 29\frac{1}{3}$: portion of $29\frac{1}{3}$ travelled by $A = \frac{88 \times 4}{27}$

$= 16\frac{8}{27}$ miles

$\therefore$ Distance from London $= 16\frac{8}{27} + 10 = 26\frac{8}{27}$ miles.

(7) See B. (7). (8) See XXXI. (59).

(9) $1.\dot{4}2857\dot{1} \times 1\frac{\overset{7}{\not{6}\not{3}}}{\not{9}\not{9}_{11}} = 1\frac{3}{7} \times 1\frac{7}{11} = \frac{10}{7} \times \frac{18}{11} = 2\frac{26}{77}$ product

$$1\frac{3}{7} \div 1\frac{7}{11} = \frac{\overset{5}{\not{1}\not{0}}}{7} \times \frac{11}{\not{1}\not{8}_{9}} = \frac{55}{63} \text{ quotient}$$

$\therefore$ $2\frac{26}{77} - \frac{55}{63} = 1\cdot\dot{4}6$ difference.

0) $20 \times 87\frac{1}{2} = 175$
$40 \times 95 = 380$
$50 \times 85 = 425$
$11 \quad 11)980$
Average price $= 89\frac{1}{11}$

$$\text{average rate} = \frac{100 \times 3 \times 11}{980} = 3\tfrac{18}{49}.$$

$\therefore 89\frac{1}{11} : 100 : 3 :$ average rate.

1) Required number $= \dfrac{29\frac{5}{9} \times 17\frac{10}{90}}{3 \times 2\frac{4}{9}} = \dfrac{266 \times 86 \times 9}{9 \times 5 \times 3 \times 22}$

$= 69{\cdot}32\dot{1}$ yards. *Ans.*

2) $$\frac{4\frac{1}{9} \div 6\frac{1}{6}}{\frac{11}{23} + \frac{35}{69}} + \frac{7\frac{5}{11} \times 3\frac{3}{11}}{\frac{5}{9} - \frac{3}{7}} \div 6\tfrac{49}{55}$$

$$= \frac{37}{9} \times \frac{6}{37} \times \frac{69}{68} + \frac{32}{11} \times \frac{120}{41} \times \frac{63}{8} \times \frac{55}{378} = \frac{23}{34} + \frac{105}{4} = 26\tfrac{63}{68}$$

(2, 23, 41, 21, 63, 5; 34, 4, 6; 2)

I.

1) See H. (10).

2) If the charge of first be 1 ; $\therefore$ the charge of second is $1\frac{1}{3}$
Now gain of second over first in 15 shots $= 1\frac{1}{3} \times 7 - 1 \times 8$
$= 9\frac{1}{3} - 8 = 1\frac{1}{3}$. $\therefore 1\frac{1}{3} : 36 :: 15$ shots : required number $- 36$

$\therefore$ Required number $= \dfrac{36 \times 3 \times 15}{4} + 36 = 441.$

3) See LVIII. (253).

4) £$5\frac{1}{4}$: £126 13*s.* $1\frac{1}{2}$*d.* :: 100 : sum invested

$\therefore$ sum invested $= \dfrac{\text{£126 } 13s. \ 1\frac{1}{2}d. \times 100}{5\frac{1}{4}} =$ £2412 10*s.*

Now £75 : £3 :: £2412 10*s.* : price of 3 per cents.

$\therefore$ Price of 3 per cents. $= \dfrac{\text{£2412 } 10s. \times 3}{75} = 96\frac{1}{2}$

(5) Required ratio $= \dfrac{\begin{matrix}43\\ \not1\not2\not9\\ \not3\not8\not7\\ \not1\not9\cdot\not3\not5\end{matrix} \times \begin{matrix}11\\ \not2\not2\\ \not4\cdot\not1\not8\end{matrix} \times \begin{matrix}32\\ \cdot\not6\not4\end{matrix} \times \begin{matrix}1\\ \cdot\not3\not1\end{matrix}}{\begin{matrix}\not1\not0\cdot\not1\not5\\ 203\end{matrix} \times \begin{matrix}\not1\not3\cdot\not0\not2\\ \not6\not5\not1\\ \not2\not1\not0\not0\\ 700\end{matrix} \times \begin{matrix}\not1\cdot\not1\not4\\ \not6\\ \not2\end{matrix} \times \cdot 65}$

$= 43 \times 11 \times 32 : 203 \times 7 \times 65 = 15136 : 92365$

(6) 115 : 15 :: £75000 : contractor's gain

$\therefore$ Required gain $= \dfrac{75000 \times 15}{115} = £9782\ 12s.\ 2\frac{2}{23}d.$

Now since 20 per cent. on 1 = 10 per cent. on 2, the alteration in price does not affect his gain.

(7) $4\frac{3}{8}$: 4 :: 100 : required price

$\therefore$ Required price $= \dfrac{4 \times 100 \times 8}{35} = 91\frac{3}{7}$

(8) $\sqrt[3]{42{\cdot}875} = 3{\cdot}5$ the edge of the box

$\therefore$ Required cost $= \dfrac{3{\cdot}5 \times 3{\cdot}5 \times 6 \times 1\frac{1}{3}s.}{7 \times 20} = 10s.\ 10\frac{2}{11}d.$

(9) Loss on 360 shares $= (2\frac{13}{16} - 2\frac{3}{8}) \times 360 = £157\ 10s.\ 0d.$

Brokerage $= (2\frac{13}{16} + 2\frac{6}{16}) \times 360 \times \frac{1}{200} = 9\ 6\ 9$

$\therefore$ His total loss $= £166\ 16s.\ 9d.$

(10) See XXIX., Exs.

(11) Required increase $= \dfrac{24\not0\not0\not0 \times 6}{28\not0\not0\not0} = 5\frac{1}{7}$

(12) See XXXVIII., Ex. 9.

J.

(1) Gross income $= \dfrac{£1250 \times 100}{96} = £1302\ 1s.\ 8d.$

(2) See XL., Ex. 1.

(3) Required amount $= \dfrac{£76\ 3s.\ 10\frac{1}{2}d. \times 100}{365d.} = £5010$

(4) See LVIII. (257). (5) Elementary.

(6) When simplified the quantities are $3\frac{2}{3}$, $3\frac{9}{32}$, $3\frac{39}{50}$, $3\frac{121}{250}$, $3\frac{193}{900}$, and the fractions become

$$\frac{48000, 20250, 56160, 34848, 15440}{72000}$$

$\therefore$ 1·8 of 2·1, $3\frac{2}{3}$, &c. *Ans.*

(7) See (6) above, and XLII.

(8) $(£·203 - £·118) \times 5 = £·425 = 8s.\ 6d.$

(9) $\sqrt[3]{3} \times 6 = 8·653$...one side
$\sqrt[3]{3} \times 5 = 7·211$...the second
$\sqrt[3]{3} \times 4 = 5·76$ ...the third.

(10) See XXVIII(*a*).

(11) Required income $= \dfrac{£4700 \times 3}{95\frac{3}{8}} = £147\ 16s.\ 8\frac{760}{763}d.$

Required rate $= \dfrac{3 \times 100}{95\frac{3}{8}} = £3\frac{111}{763}.$

(12) Interest on £2300000 at $4\frac{1}{2}$ per cent. per annum $= £97750$

Net receipts $= \dfrac{£635000 \times 55}{100} = £349250$

Sum for shareholders $= £349250 - £97750 - £11000$
$= £240500$

$\therefore$ Required dividend $= \dfrac{£240500 \times 100}{3700000} = 6\frac{1}{2}$ per cent.

K.

(1) Elementary. (2) See XXV., Ex. 1

(3) Number of cubic feet left $= 12 \times 8\frac{1}{6} \times 6\frac{1}{2} - \frac{4000 \times 277}{1728}$

$= 689 - 641\frac{367}{432} = 47\frac{65}{432}$

Now $47\frac{65}{432} \times £2\frac{19}{96} = £103\ 12s.\ 7\frac{751}{864}d.$ *Ans.*

(4) It is evident the number of lambs does not affect the n price. (See *Alligation*)

$$\left.\begin{matrix} \therefore 100s. \\ 5s. \end{matrix}\right\} 20s. \left\{\begin{matrix} 15 \text{ calves} \\ 80 \text{ goats} \\ 5 \text{ lambs} \end{matrix}\right\} \begin{matrix} \text{or 3, 16, and 81} \\ \text{or 6, 32, and 62} \end{matrix}$$

These three answers will suit the conditions of the ques

(5) See XL., Ex. 2.

(6) Required weight $= \frac{37}{40}$ of $\frac{1}{66}$ of a pound $= \frac{37 \times 12 \times 20d}{40 \times 66}$

$= 3$ dwts. $8\frac{8}{11}$ grs.

(7) See C. (4).

(8) Number of sovereigns $= £280 \div 1\frac{1}{6} = 240$

$\therefore$ Number of shillings $= 720$, and pence 960.

(9) Content of wood $= (16 \times 12 \times 8) - (15 \times 11 \times 7)$

$= 1536 - 1155 = 381$ in. $= 3$ lbs. weight

Required ratio is the weight of 1 in. of wood : 1 in. s

$$= \frac{3}{381} : \frac{22}{1155} = \frac{\cancel{3}}{\cancel{381}} \times \frac{\cancel{1155}^{105}}{\cancel{22}} : \frac{\cancel{22}}{\cancel{1155}} \times \frac{\cancel{381}^{127}}{\cancel{3}} = 105 : 254$$

) Price of (12 cwt. 3 qrs. 7 lbs. × 13) at £2 16*s.* per cwt. = £345 12*s.* $4\frac{1}{8}d.$

Interest on £345 12*s.* $4\frac{1}{8}d.$ for 8 months at 5 per cent. = £11 10*s.* $4\frac{15}{16}d.$

∴ Required sum = £420 − £357 2*s.* $9\frac{1}{16}d.$ = £62 17*s.* $2\frac{15}{16}d.$

) See LXI. (3). (12) See XXXVIII. Ex. 10.

L.

) See XXIX. Ex. 7.

) Earnings of first class $= \frac{270 \times 4}{27} \times 40 \times 2d.$ = £13 6 8

„ „ second $= \frac{270 \times 7}{27} \times 35 \times 1\frac{1}{2}d.$ = 15 6 3

„ „ third $= \frac{279 \times 16}{27} \times 25 \times 1d.$ = 16 13 4

∴ Total earning, £45 6 3

) Triangle ABm = 182 × 60 = 10920 links.

„ CDn = 250 × 180 = 45000

„ DEy = 190 × 85 = 16150

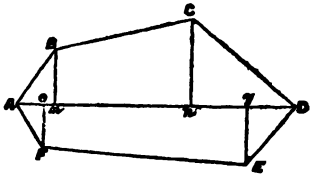
„ AFo = 68 × 95 = 6460

Trapezium BCnm = 440 × 216 = 95040

„ EFoy = 655 × 163 = 186765

Total area = 280335

∴ 280335 links ÷ 100000 = 2 ac. 3 rds. 8·536 pls.



(4) Take £27, salary of first year

1st year's salary	£27,	savings	£13
2nd	„	„	36	„	24
3rd	„	„	48	„	32
4th	„	„	64	„	$42\frac{2}{3}$
			Total savings		$£116\frac{2}{3}$

$\therefore 116\frac{2}{3} : 259\frac{7}{27} :: £27$: required salary

$\therefore$ Required salary $= \frac{27 \times 700 \times 3}{27 \times 35} = £60.$

(5) See LVIII. (21).

(6) Required price $= (14 \times 130 + 57 \times 14 + 29 \times 36)$
$\therefore 20 \times 3s.\ 9d. = £34\ 6s.\ 7\frac{1}{2}d.$

(7) $\sqrt[3]{220{\cdot}013504} = 6{\cdot}84$ chains $= 684$ links. *Ans.*

(8) Gain on £1000 $= 10 \times 3\frac{1}{2} = £35$; but the net gain is £6 5*s.*

$\therefore$ Loss must be $£35 - £6\frac{1}{4} = £28\frac{3}{4}$

Loss on £100 Stock $= £90 - 84\frac{1}{4} = 5\frac{3}{4}$

$\therefore$ Stock sold at a loss $= \frac{28\frac{3}{4} \times 100}{5\frac{3}{4}} = £500$

$\therefore$ Required sum $= \frac{1500 \times 90}{100} = £1350$

First income $= \frac{1500 \times 3}{100} £ = £45$

Second „ $= \frac{(1350 + 6\frac{1}{4}) \times 4}{100} = £54\ 5s.$

$\therefore$ Required difference $= £54\ 5s. - £45 = £9\ 5s.$

9) If the first's capital be 1, that of the second is 2, and the third $\frac{3}{2} = 1\frac{1}{2}$; then divide £5000 into parts proportional to 1, 2, $1\frac{1}{2}$, and $4\frac{1}{2}$.

0) See (15).

1) The three men walk $\frac{1}{10}$, $\frac{1}{18}$, and $\frac{1}{90}$, respectively, in a minute; the first gains on the second $\frac{1}{10} - \frac{1}{18} = \frac{2}{45}$, and on the third $\frac{1}{10} - \frac{1}{90} = \frac{4}{45}$ in a minute

$\therefore$ the first and third will be together every $11\frac{1}{4}$ minutes, and the first and second every $22\frac{1}{2}$ minutes, the shortest time before the three can be together.

2) The first man goes in $10'' = \frac{4 \times 1760 \times 10}{60 \times 60} = 19\frac{5}{9}$ yards

$\therefore$ Train „ $10'' = 88 + 19\frac{5}{9} = 107\frac{5}{9}$ yards

$= 22$ miles an hour

Train „ $9'' = \frac{9}{10}$ of $107\frac{5}{9} = 96\frac{4}{5}$ yards

$\therefore$ Second man „ $9'' = 96\frac{4}{5} - 88 = 8\frac{4}{5}$ yards

$= 2$ miles an hour

In 20′ the train is $\frac{22}{3} - \frac{4}{3} = 6$ miles before the first man

$\therefore$ Since the first man gains 2 miles an hour on the second, he will overtake him in 3 hours

$\therefore$ the train will be $22 \times 3 - 3 \times 2 = 60$ miles distant.

M.

1) Required number of lines = 41·06328 ÷ ·0438 = 937, leaving a remainder = ·02268 in., which is the length of the remaining line.

2) Average decrease = (£369 18*s.* 10*d.* − £360 1*s.* 1*d.*) ÷ 21 = 9*s.* 5*d.*

$\therefore$ Required average = £374 9*s.* 8*d.* − 9*s.* 5*d.* = £374 0*s.* 3*d.*

(3) Breadth in yds. $= \sqrt{\left(\frac{6\text{ac. }900\text{yds.}}{3}\right)} = \sqrt{9980} = 99{\cdot}899\ldots$

(4) Loss per cent $= (£1 - 6s.\ 10\frac{1}{2}d.) \times 100 = 65\frac{5}{8}$.

(5) Required gain $= 15 +$ his gain per cent. in selling
$= 15 + \frac{115 \times 15}{100} = 32\frac{1}{4}$

(6) See XLV. (1°).

(7) 270000 : 210000 :: £54 : required price

$\therefore$ Required price $= \frac{210000 \times 54}{270000} = £42$, that is, 8 discount

(8) Required price $= \frac{3\frac{1}{4} \times 100}{5} = £65$

90 : 72 :: 65 first income : second income

$\therefore$ Second income $= \frac{72 \times 65}{90} = £52$

$\therefore$ $65 - 52 = £13$ decrease.

(9) If A takes 6, B will take $4\frac{1}{2}$; $\therefore$ the number 1155 is to be divided in proportion to 6, $4\frac{1}{2}$, and 7.

(10) Since $36000 = \frac{3}{4}$ of remainder, $12000 = \frac{1}{4}$ of it.

$\therefore$ $48000 + (8000 - 6000) = \frac{5}{8}$ of the army $= 50000$

$\therefore$ Whole army $= 50000 + 10000 = 60000$

(11) $4{\cdot}\dot{2}85714\dot{} \times 4{\cdot}\dot{0}\dot{9} = 4\frac{2}{7} \times 4\frac{1}{11} = \frac{30}{7} \times \frac{45}{11} = 17{\cdot}\dot{5}32467\dot{}$

Again, $\frac{30}{7} \div \frac{45}{11} = \frac{\overset{2}{\cancel{30}}}{7} \times \frac{11}{\underset{3}{\cancel{45}}} = \frac{22}{21} = 1{\cdot}\dot{0}47619\dot{}$.

12) The first will be $\frac{3}{4}$ hour $+ \frac{12}{5\frac{1}{4}} = 2\frac{2}{3}\frac{7}{3}$ hours in reaching B

The second will go $2\frac{2}{3}\frac{7}{3} \times 3\frac{1}{2} = 10\frac{5}{8}$ miles in the same time

$\therefore$ Distance still to be travelled $= 15 - 10\frac{5}{8} = 4\frac{3}{8}$ miles.

N.*

(1) 236 : 240 :: £576 6*s.* 8*d.* : £586 2*s.* $0\frac{24}{59}$*d.* ***Ans.***

(2)

		£	s.	d.
		161	6	6
				3
		483	19	6 cost of 3 ac.
1 rood = $\frac{1}{4}$ of an ac.		40	6	$7\frac{1}{2}$
5 pls. = $\frac{1}{8}$ of 1 rd.		5	0	$9\frac{15}{16}$
2 poles = $\frac{1}{20}$ of 1 rd.		2	0	$3\frac{39}{40}$
88 yds. = $\frac{1}{55}$ of 1 ac.		2	18	$7\frac{53}{55}$
		£534	5	$11\frac{331}{880}$ ***Ans.***

(3) Since 3605 c. ft. 64 in. = 6229504 in.

Ans. $= \sqrt[3]{6229504}$ in. = 184 in. = 15 ft. 4 in.

(4) See XXVIII. (*a*).

(5) Cash handed broker $= \frac{\cancel{46}\cancel{0} \times 2}{\cancel{2}\cancel{3}} = £40.$

Cash broker must pay $= \frac{\cancel{46}\cancel{0} \times \cancel{5}}{\cancel{2}\cancel{4} \times 2} = £28\ 15s.$;

$\therefore$ ***Ans.*** $= £40 - £28\ 15s. = £11\ 15s.$

(6) Interest on £1000 for a year = £50

Interest by four quarterly payments :—

1000×3 m. $= 3000$
750×3 m. $= 2250$
500×3 m. $= 1500$
250×3 m. $= 750$
7500

$\therefore$ ***Ans.*** $= £50 - \frac{£75\cancel{0}\cancel{0} \times 5}{12\cancel{0}\cancel{0}} = £18\ 15s.$

(7) $2\frac{223}{330} \times 2\frac{223}{330} = \frac{68{\cdot}89}{3\cancel{0} \times 3\cancel{0}} = 7{\cdot}65\dot{4}$

* For questions under N. in 9th Edition see LII. (32), &c.

(8) Interest $= \frac{£7747\ 5s. \times \cancel{6}}{2 \times \cancel{100}\ 20} = £193\ 13s.\ 7\frac{1}{2}d$

Discount $= \frac{£7747\ 5s. \times 100}{102\frac{1}{2}} = £188\ 19s.\ 1\frac{31}{41}d.$

$\therefore$ *Ans.* $= £193\ 13s.\ 7\frac{1}{2}d. - £188\ 19\ 1\frac{31}{41} = £4\ 14\ 5\frac{61}{82}$

(9) Annual dividend on £1010 $= £5\ 10s.\ 0d.$

„ Bonus „ $5\ 6\ 0\frac{3}{5}$

$\therefore 240 : 235 :: (£5\ 10s. + £5\ 6s.\ 0\frac{3}{5}d.) : £10\ 16s.\ 6\frac{141}{440}d.$

(10) From 9th to 16th *av.* $= 34{\cdot}6°$

„ 10th „ 17th „ $= 39{\cdot}8°$

$\therefore$ Increase $= 5{\cdot}2$

9th is $30{\cdot}5$

Ans. $= \frac{41{\cdot}6 = 5{\cdot}2 \times 8}{72{\cdot}1°}$

(11) Widow's share $= \frac{1}{3}$, sons $= \frac{1}{2}$

$\therefore$ each daughter's $= \frac{1-(\frac{1}{3}+\frac{1}{2})}{4} = \frac{1}{24}$; but $\frac{1}{24} + £326 = \frac{1}{3}$

$\therefore$ *Ans.* $= 11 : 24 :: 326 : £237\frac{1}{11}$

(12) Cost in British pence of travelling 1 kilo. in France

$= \frac{38{\cdot}16}{\cancel{240} \times 25{\cdot}44} \times \cancel{240}$; $\therefore$ Cost of 1 English mile in France

$\frac{3816 \times 1760 \times 36}{2544 \times 39{\cdot}7068 \times 1000} d.$

Cost of 1 mile in England $= \frac{14s.\ 7d.}{70} = \frac{5}{2}d.$

$\therefore$ *Ans.* $= \frac{5}{2} : \frac{3816 \times 1760 \times 360}{2544 \times 397068}$

$$= \frac{5}{21} \times \frac{2544}{212} \times \frac{33089}{106} : \frac{2}{3} \times \frac{3}{21} \times 1760 \times \frac{3}{60}$$

$$= 33089 : 31680$$

13) 1 man would do the work in $45 \times 35 = 1575$ days.

$$\text{Now } \frac{1575}{15(35 + 28 + 21 + 14 + 7)} = 1$$

$\therefore$ *Ans.* $= 15 \times 5 = 75$ days.

14) Cost of papering $= \frac{(16\frac{7}{12} + 13\frac{5}{12}) \times 2 \times 10\frac{1}{2}}{3 \times 1\frac{2}{3} \times 240} \times 10d.$

$$= \frac{30 \times 2 \times 21 \times 3 \times 2 \times 10}{3 \times 5 \times 2 \times 240 \times 2} = £5\ 5s.$$

15) Since $100 - (41 + 56) = 3$, it is plain 3 per cent. of receipts $= £15000$.

$\therefore$ 1 per cent. $= 5000$, the whole receipts $= £500000$

Now amount paid to shareholders

$$= \frac{£500000 \times 56}{100} = £280000$$

$$\therefore \text{Capital} = \frac{£280000 \times 100}{3\frac{1}{2}} = £8000000 \text{ } \textit{Ans.}$$

O.

(1)

	With stream	$= \frac{1}{2}$ in an hour.
	Against ,,	$= \frac{1}{3}$,,
	Twice stream	$= \frac{1}{6}$
$\therefore$	Stream	$= \frac{1}{12}$
$\therefore$	Rate of rowing	$= \frac{1}{2} - \frac{1}{12} = \frac{5}{12}$

$\therefore$ *Ans.* 5:1

(2) Question $= \frac{3}{2} \times \frac{14}{5} + \frac{55}{8} \times \frac{4}{11} - \left(5\frac{1}{2} + \frac{\frac{24}{100} + \frac{48}{99}}{2\frac{1}{5} - \frac{58}{90}}\right)$

$$= \frac{21}{5} + \frac{5}{2} - (5\tfrac{1}{2} + \tfrac{174}{235} \times \tfrac{9}{14}) = 6\tfrac{7}{10} - 5\tfrac{87}{176} = \tfrac{123}{176} \text{ } \textit{Ans.}$$

(3) 659 c. ft. 1248 in. = 659 c. ft. 8′ 8″
and 26 sq. ft. 6 in. = 26 sq. ft. 0′ 6″

26 sq. ft. 0′ 6″)659c.ft. 8′ 8″(20+5
520 10′ 0″
138 10′ 8″(5
130 2′ 6″
8 8′ 2″
12
104′ 2″(4′
104′ 2″

∴ 25 ft. 4 in. *Ans.*

(4) Since the areas of similar figures are as the squares of their diagonals, we have,
15 yards : 40×4840 : : 5^2+3^2 : Diagonal^2
∴ Diagonal$=\sqrt{\frac{40\times 4840\times 34}{15}}=\sqrt{438826\cdot 66}$
$=662\cdot 4$ . . . . *Ans.*

(5) When A=60; when B=44 ∴ When B is 44 A will be
D=55 C=40 55 : 44 : : 60 : 48
D=36

Now, when A is 48 D is 36, what will D be when A is 72?
48 : 72 : : 36 : 54
∴ *Ans.* =72—54=18.

(6) Taking 15 per cent. off £96 and off 56*s.* we have £81 12*s.* and $47\frac{3}{5}s.$
∴ £81 12*s.* and the price of the wheat at $47\frac{3}{5}s.$ per qr.= £96 and the price at 38*s.* per qr.
∴ No. of qrs. $=\frac{£96-£81\ 12s.}{47\frac{3}{5}s.-38s.}=\frac{1440}{48}=30.$ *Ans.*

(7) When the square root of denominator in its lowest terms is not formed of *twos* or *fives*, or powers of these;
$\sqrt{\cdot 197530864}=\sqrt{\frac{16}{81}}=\frac{4}{9}=\cdot\dot{4}$ *Ans.*

8) The question really is, how many grs. will make 56 cubic inches?

$$1728 : 56 : : 10 \text{ cwts. } 95 \text{ lbs.}$$

$$\therefore Ans. = \frac{\overset{45}{\cancel{405}} \quad 7 \quad \overset{875}{\cancel{1000}}}{\underset{\cancel{216}}{\cancel{1215}} \times \underset{\cancel{8}}{\cancel{56}} \times \underset{\cancel{2}}{\cancel{1000}}}{\underset{\cancel{72}}{\cancel{1728}}} = 275625.$$

9) From noon on Monday until $10\frac{1}{4}$ on Saturday $= 118\frac{1}{4}$ hrs., 1 day, true time $= 86400$ secs., and 1 day on clock $= 86590$ secs.

$$\therefore \overset{\text{secs.}}{86400} : 118 \text{ hrs. } 15' : : \overset{\text{secs.}}{86590} : \textit{Answer}$$

$$\therefore Ans. = \frac{118\frac{1}{4} \times 86590}{86400} = 118 \text{ hrs. } 30' \; 36\tfrac{7}{48}''$$

to which add 10′ and we have 40′ $36\frac{7}{48}''$ past 10.

10) $\begin{array}{r|l} 11 & 2431 \\ \hline 13 & 221 \\ \hline & 17 \end{array}$ $\begin{array}{r|l} 11 & 2717 \\ \hline 13 & 247 \\ \hline & 19 \end{array}$ $\begin{array}{r|l} 11 & 3553 \\ \hline 17 & 323 \\ \hline & 19 \end{array}$ $\begin{array}{r|l} 13 & 4199 \\ \hline 17 & 323 \\ \hline & 19 \end{array}$

$\therefore 2431 = 11 \times 13 \times 17$
$2717 = 11 \times 13 \times 19$
$3553 = 11 \times 17 \times 19$
$4199 = 13 \times 17 \times 19$

$\therefore$ L. C. M. $= 11 \times 13 \times 17 \times 19 = 46189$

and sum of fractions $= \frac{7 \times 19 + 8 \times 17 + 9 \times 13 + 10 \times 11}{46189} = \frac{496}{46189}$.

11) Question $= \frac{2 \times \sqrt{1 + \frac{1}{3}}}{5 \times \sqrt{1 + \frac{1}{3}} \times \sqrt{1 - \frac{1}{5}} \times \sqrt{1 - \frac{1}{5}}} + \frac{11}{5} \times \frac{5}{11} \times \frac{22}{39} +$

$\frac{811965}{999999} = \frac{2}{5 \times \frac{4}{5}} + \frac{22}{117} + \frac{95}{117} = \frac{2}{5} \times \frac{5}{4} + \frac{22 + 95}{117} = 1\frac{1}{2}$. *Ans.*

12) Bronze $= 91$ per cent. copper $+ 6$ zinc $+ 3$ tin
Bronze and bell-metal $= 88$,, $+ 4\frac{7}{8}$,, $+ 7\frac{1}{8}$,,

Now, since bell-metal contains no zinc, the quantity of zinc was not affected by the mixture; and

zinc. copper.
$6 : 4\frac{7}{8} : : 91 : 73\frac{15}{16}$

$\therefore$ Copper in bell-metal $= 88 - 73\frac{15}{16} = 14\frac{1}{16}$.

Again, since there is half as much tin as zinc in bronze, we have tin in bell-metal $= 7\frac{1}{8} - 4\frac{7}{8} \div 2 = 4\frac{1}{16}$

$\therefore$ *Ans.* $= 14\frac{1}{16} : 4\frac{1}{16} = 225 : 75 = 3 : 1$.

P.,

(1) In 15 shots of A he kills 5 birds, and B who has only fired 9 has missed $4\frac{1}{2}$

$\therefore 4\frac{1}{2} : 36 : : 5 : 40$. *Answer.*

(2) $5760 \times \frac{11}{12} : 179 \times \frac{925}{1000} : : £46\frac{5}{8} : Ans.$

$$\therefore Ans. = \frac{179 \times \cancel{9}\cancel{2}\cancel{5} \times 1\cancel{2} \times 373}{\cancel{1}\cancel{0}\cancel{0}\cancel{0} \times 11 \times \cancel{5}\cancel{7}\cancel{6}\cancel{0} \times 8} = £1\ 9s.\ 2\tfrac{6373}{7040}d.$$

(3) (*a*) 7000
5760

$= 12760 \times \frac{5}{11} \div 5760 = \frac{58000}{57600} = 1$ lb. 1 dwt. 16 grs.

(*b*) $= \frac{58000}{70000} = 13$ oz. $4\frac{2}{35}$ drs.

(4) See solution of LI. No. (12).

(5) Depth $= \frac{294\frac{1}{4}}{13\frac{3}{8} \times 6} = \frac{1177 \times 8}{4 \times 107 \times 6} = 3$ ft. 8 in.

Weight of water $= \frac{1177 \times 1728 \times 505}{4 \times 2 \times 7000} = 18341\frac{4}{175}$ lbs.$=$

8 tons 3 cwts. 3 qrs. $1\frac{4}{175}$ lbs. *Ans.*

(6) If W mark wine and *w* water.

	I. vessel.	II. vessel.
After first change	$11w + 1W$	$5W + 1w$
	$+ \frac{1}{6} + \frac{5}{6}$	
	$- \frac{11}{12} - \frac{1}{12}$	
After second change	$10\frac{1}{4}w + 1\frac{3}{4}W$	$4\frac{1}{4}W + 1\frac{3}{4}w$
	$+ \frac{7}{24} + \frac{17}{24}$	
	$- \frac{41}{48} - \frac{7}{48}$	
After third change	$9\frac{11}{16}w + 2\frac{5}{16}W$	$3\frac{11}{16}W + 2\frac{5}{16}w$
	$+ \frac{37}{96} + \frac{59}{96}$	$+ \frac{37}{192} + \frac{155}{192}$
	$- \frac{155}{192} - \frac{37}{192}$	$- \frac{59}{96} - \frac{37}{96}$
Ans.	$= 9\frac{11}{64}w + 2\frac{11}{64}W$	$3\frac{11}{64}W + 2\frac{11}{64}w$

') See F. (3),

') 8 ft.—5 ft. 6 in.=2 ft. 6 in., height of lower wall above the man's eye.

$\therefore$ 20 ft. : 30 ft. : : $2\frac{1}{2}$: $3\frac{3}{4}$, the height of the second wall above the man's eye.

$\therefore$ $5\frac{1}{2}+3\frac{3}{4}=9\frac{1}{4}$ feet. *Ans.*

') *Answer*=180 lbs. B

54 B = 55 A

$17\frac{3}{4}$ A = $15\frac{7}{12}$ B

51 B = 53 A

363 A = $35\frac{1}{10}$ £

$$=\frac{180\times55\times187\times53\times351\times3}{54\times53\times12\times51\times10\times363}$$

$=$£16 5*s.* *Ans.*

') 1000 cubic feet weigh $62{\cdot}35\times1000$ $=62355{\cdot}5$lbs.

By approximation, $\frac{6 \text{ tons}\times20\times112\times1000}{216}=62222{\cdot}2$lbs.

$\therefore$ *Ans.* $=$ $133{\cdot}\dot{3}$ lbs.

') There are 19 intervals between 20 shots

$\therefore$ The sound met him 15″ sooner than if he had not moved, *i.e.*, it travels in 15″ the distance he walked

$$\therefore \textit{Ans.}=\frac{17600\times3\times18\frac{3}{4}}{60\times15}=\frac{\overset{220}{\cancel{17600}}\times\overset{5}{\cancel{3}}\times\overset{15}{\cancel{75}}}{\underset{4}{\cancel{60}}\times\underset{1}{\cancel{15}}\times\underset{1}{\cancel{4}}}=1100 \text{ ft. per second.}$$

') The common is $\frac{180}{100}=\frac{9}{5}$ of the centigrade

$\therefore \left(\frac{9}{5}\times24\right)+32=\frac{216}{5}+32=43\frac{1}{5}+32=75\frac{1}{5}°$;

$-8°=108$ below boiling point

$\therefore$ *Ans.* $=\frac{108\times9}{5}=194\frac{2}{5}$ below boiling point

$\therefore$ $212-194\frac{2}{5}=17\frac{3}{5}°$

$154\times\frac{9}{5}=277\frac{1}{5}°$;

$\therefore$ $212-277\frac{1}{5}=-65\frac{1}{5}°$. *Ans.*

Q.,

(1) He rows with stream 9m. + stream.
,, against ,, 9m. — stream.
∴ 9m. + stream = (9m. — stream) × 3.
9m. + stream = 27m. — 3 stream.
∴ 4 stream = 18m., and stream = $4\frac{1}{2}$. *Ans.*

(2) Question $= \frac{816\times1393-166463}{1\not0\not0\not4\not6\not3\times1\not3\not9\not3} \times \frac{1\not3\not9\not3\times1\not0\not0\not4\not6\not3}{1393\times166463+816}$

$= \frac{970225}{231883775} = \frac{1}{239}$. *Ans.*

(3) This cistern is just half a cube; hence the solution.

(4) *Ans.* $= 21\times7^2 : 20\times8^2 = 21\times49 : 20\times64 = 1029 : 1280$.

(5) The area is found just as the area of the walls of a room.

(6) A+B do $\frac{1}{12}$ in a day
A+C do $\frac{1}{15}$ in a day
B+C do $\frac{1}{18}$ in a day
∴ $2A+2B+2C = \frac{1}{12}+\frac{1}{15}+\frac{1}{18} = \frac{37}{180}$, and $A+B+C = \frac{37}{360}$
Now A will do $\frac{37}{360}-\frac{1}{18} = \frac{17}{360}$
∴ he will do the whole in $\frac{360}{17} = 21\frac{3}{17}$ days, and so on.

(7) *Ans.* $= \frac{65\not0,\not0\not0\not0\times91\times61}{1\not0\not0\times1\not0\not0} = 360815$.

(8) $\sqrt{(10\cdot4^2+14\cdot31^2)} = \sqrt{312\cdot9361} = 17\cdot69$

(*a*) Multiply numerator and denominator by $\sqrt{10}$, and
$\frac{2\sqrt{20}}{10} = \frac{\sqrt{20}}{5} = \frac{4\cdot4721}{5} = \cdot8944\ldots.$

(*b*) $\frac{1}{1-\frac{1}{5}\sqrt{20}} = \frac{1}{1-\cdot8944} = \frac{1}{\cdot1056} = 9\cdot469\ldots.$

(9) *Ans.* $= \frac{7\times\overset{13}{\not2\not2}\times23}{20\times\not4} = \frac{2093}{20} = £104\ 13s.$

(10) Average increase = 1*s.* 2*d.*
∴ The price in 1843 must exceed that of 1836 by 1*s.* 2*d.* × 7 = 8*s.* 2*d.*
∴ *Ans.* = 62*s.* 3*d.* + 8*s.* 2*d.* = 70*s.* 5*d.*

(11) See (6) above, and *Ex.* 5, page 186 in Treatise.

(12) Rise of column = 60 — 32 = 28° Fah. = $28\times\frac{5}{9} = \frac{140}{9}$ centigrade; The expansion = $\cdot00018\times\frac{140}{9} = \cdot0028$. *Again,* since ·76 of a metre = 39·37079 × ·76 = 29·9218004 in. we have, *Ans.* = 29·9218004 × 1·0028 = 30·00558144112.

R.

1) Here for every $94\frac{1}{8}+\frac{1}{20}=94\frac{7}{40}$, he has £3 10*s.* income

2) On every £72 invested he gains £8, *i.e.*, £$\frac{1}{9}$ income

$$\therefore \frac{72\times £43\ 10s.}{\frac{1}{9}} = £9396 \text{ sum invested}$$

$$\text{Second income} = \frac{£9396\times 3}{72} + £43\ 10s.$$

$$= £391\ 10s. + £43\ 10s.$$

$$= £435\ \textit{Ans.}$$

$$= £18\ 2s.\ 6d.\ \textit{Ans.}$$

3) First £73 invested produces £73 + 6 dividend
Second do. do. 73 + 3 ,,

∴ From £73 invested, a bill of £155 could, under the conditions, be paid.

$$\text{Now, } 155:1085::73:\frac{\cancel{1085}\times 73}{\cancel{155}_{1}}=£511.\ \textit{Ans.}$$

4) Present worth of bill =

$$\frac{£954\ 17s.\ 6d.\times 100}{103\frac{3}{4}} = \frac{954\frac{7}{8}\times 100\times 4}{415} = \frac{7639\times 400}{415\times 8}$$

Now, since every £100 stock sold pays £93½, we have

$$\textit{Ans.}\ \frac{7639\times 400\times 100}{415\times 8\times 93\frac{1}{2}} = \frac{7639\times \cancel{400}^{\,80}\times 100\times 2}{\cancel{415}_{83}\times \cancel{8}_{1}\times 187} = \frac{15278000}{15521} =$$

£984 6*s.* $10\frac{7918}{15521}d.$

5) From rule for finding Compound Interest:—

$$\text{Principal}\times\left(1+\frac{\text{Rate}}{100}\right)^{6} = \text{Amount} = \text{Twice Principal}$$

$$\therefore \left(\frac{100+\text{Rate}}{100}\right)^{6} = \frac{\text{Twice Principal}}{\text{Principal}} = 2$$

$$\therefore 100+\text{Rate} = 2^{\frac{1}{6}}\times 100 = 1{\cdot}122\times 100 = 112{\cdot}2$$

$$\therefore \textit{Ans.} = 112{\cdot}2 - 100 = 12{\cdot}2.$$

(6) If A purchase £100 of each stock, he has $6\frac{1}{4}$ incom
from $91+97\frac{1}{2}=£188\frac{1}{2}$ capital
Now, if B invest half of this sum in each, his income will b
$\frac{94\frac{1}{4}\times 3}{91}+\frac{94\frac{1}{4}\times 3\frac{1}{4}}{97\frac{1}{2}}=3\frac{3}{56}\frac{2}{4}+3\frac{17}{120}=6\frac{209}{840}$. Now, $6\frac{1}{4}-6\frac{209}{840}$
$=\frac{1}{840}$ the difference in income on £188½ of capital
$\therefore \frac{1}{840}:\frac{1}{20}::188\frac{1}{2}:Ans.$
$\therefore Ans.=\frac{840\times 377}{20\times 2}=21\times 377=£7917.$

(7) Statement $60:100::\frac{5000000\times 5}{100}$

$235:240$

(8) See solution of (25), page 153.

(9) $\frac{5}{124\frac{1}{2}}:\frac{4\frac{5}{6}\times 7\frac{1}{2}}{100\times 8\frac{1}{3}}=5\times 100\times 8\frac{1}{2}:4\frac{5}{6}\times 7\frac{1}{2}\times 124\frac{1}{2}=$
$5\times \overset{20}{\cancel{100}}\times 17\times \overset{2}{\cancel{6}}\times 2\times \cancel{2}:29\times \overset{3}{\cancel{15}}\times \overset{83}{\cancel{249}}\times \cancel{2}=$
$6800:7221.$ *Ans.*

(10) $\frac{£3500}{7}\times 2=£1000$ loss on Great Nuggets

$\frac{500}{1\frac{1}{4}}\times 3\frac{3}{4}=\frac{1500}{£500}$ gain on Agua Frias

Brokerage $=\frac{4500+4000}{100\times 8}=\frac{8500}{800}=£10\ 12s.\ 6d.$

$\therefore$ Net gain $=£500-£10\ 12s.\ 6d.=£489\ 7s.\ 6d.$ *Ans.*

(11) $3:5::96:\frac{\overset{32}{\cancel{100}}\times \overset{4}{\cancel{5}}\times \cancel{100}}{\cancel{3}\times \cancel{125}\ \cancel{25}}=128.$ *Ans.*
$125:100$

(12) $3:4\frac{1}{8}:94:\frac{\overset{11}{\cancel{33}}\times \overset{47}{\cancel{94}}}{\underset{4}{\cancel{8}}\times \cancel{3}}=\frac{517}{4}=129\frac{1}{4}$

Now, income $=\frac{£5210\times 4\frac{1}{8}}{130\frac{1}{4}}=£165.$ *Ans.*

S.

1). Circuit = (24 ft. $8\frac{1}{2}$ in. + 16 ft. $3\frac{1}{2}$ in.) × 2 = 82 ft.

$$\text{Now } Ans. = \frac{82 \times 23 \times 4s.}{20 \times 2} = \frac{943}{5} = £188\ 12s.$$

2) The $Ans. = \dfrac{3\frac{3}{4} - 2\frac{1}{8}}{6\frac{1}{12} - 4\frac{1}{4}} \times \dfrac{\frac{225-196}{49 \times 25}}{\frac{2025-1936}{121 \times 27}} \div \dfrac{\frac{29}{35}}{\frac{89}{99}}$

$$= \frac{13}{8} \times \frac{3}{11} \times \frac{29}{49 \times 25} \times \frac{11 \times 3 \times 7}{121 \times 27} \times \frac{35 \times 99}{89 \times 29} = \frac{117}{140}$$

3) See C. (8).

4) Since the square of the diagonal of a square = twice its area, and since 1 acre = 4840 yards, we have $Ans. = \sqrt{4840 \times 4}$ $= \sqrt{19360} = 139$ yds. 5 in.

5) See page 131 in *Arithmetic.* (6) See K (11).

7) Discount $= \dfrac{2598 \times 15}{115}$ by the rule.

Since difference between interest and discount = interest on the discount

$$Ans. = \frac{£2598\frac{3}{4} \times 15 \times 3 \times 5}{115 \times 100} = \frac{5847\frac{3}{16}}{115} = £50\ 16s.\ 10\frac{12}{23}d.$$

8) Reduce to grs. and then divide by 7000.

9) By reducing to a vulgar fraction and finding its value of £3 we have $\dfrac{667877 \times 60s.}{2499750} = 16s.\ 0\frac{104}{2777}d.$

10) *See B (8).* (12) See O (10).

(11) Amount in consols $= \frac{\overset{300}{\cancel{6}\cancel{9}00 \times 100}}{\cancel{9}\cancel{2}} = £7500$; and his income will be the interest on this sum = £225.

Income had he taken the $2\frac{1}{2}$ per cent. stock

$$= \frac{69 \times \cancel{2}\frac{1}{\cancel{2}} \times 11\cancel{0}}{\cancel{1}\cancel{0}\cancel{0}} = \frac{759}{4} = £189\ 15s.;$$

$\therefore$ *Ans.* £225 − £189 15*s.* = £35 5*s.*

T.

(1) Stock in his name $= £700 + \frac{585 \times 100}{97\frac{1}{2}} = £1300$

Gain on £700 $= (95 - 94\frac{1}{2}) \times 7 = £3\frac{1}{2}$; Loss on $= (97\frac{1}{2} - 96\frac{1}{4}) \times 6 = 7\frac{1}{2}$. $\therefore$ Net loss = £4.

(2) Taking the rate per cwt. as standard, we have

$$105\tfrac{1}{2}s. : 3\tfrac{1}{\overset{28}{6}} \times 112s. :: 94\tfrac{1}{2} : x$$

$$\therefore x = \frac{19 \times \cancel{1}\cancel{1}\cancel{2} \times \cancel{1}\cancel{8}\cancel{9}}{\cancel{6} \times 211 \times \cancel{2}} = \frac{33481}{211} = 317\tfrac{145}{211}$$

$\therefore$ *Ans.* $= 217\frac{145}{211}$ gain per cent.

(3) Stock purchased $= \frac{£1638 \times 100}{91} = £1800.$

Gain on £1200 $= 2\frac{1}{2} \times 12 = 30$
Loss on £600 $= 6 \times 6 = 36$ $\Big\}$ $\therefore$ *Ans.* = £6 loss.

(4) 2*s.* 8*d.* + $\frac{1}{10}$ of 2*s.* 8*d.* = 35·2*d.*, and 2*s.* 9*d.* + 2*s.* 9*d.* = 36·2*d.* Hence we have

$$\left.\begin{matrix}35{\cdot}2 \\ 36{\cdot}3\end{matrix}\right\rangle \overset{\text{mean}}{36} \left\langle \begin{matrix}3 \\ 8\end{matrix}\right\}$$ consequently they must be mix

3:8; $\therefore$ *Ans.* = 8:3::495:185$\frac{5}{8}$ lbs.

(5) See **Ex. 5, p. 181 in Treatise, and LI. (12).**

T.

(6) So far as the excess in fare is concerned, there was twice as much on every mile travelled 1st class as on every mile gone 2nd class; *i.e.*, going $\frac{1}{4}$ 1st class = $\frac{2}{4}$ 2nd class, or the whole distance + $\frac{1}{4}$ of the distance, $\therefore \frac{5}{4}$ the distance = 8*s.* 9*d.*, or distance = $105 - 105 \div 5 = 84$.

(7) Average selling price per ton = $\frac{£37\text{-}$}{1000} = 7\frac{2}{5}s.$ Then

$$\left.\begin{matrix} 10 \\ 4 \end{matrix}\right\rangle 7\tfrac{2}{5} \left\langle \begin{matrix} 3\frac{2}{5} \\ 2\frac{3}{5} \end{matrix}\right\} \therefore 3\tfrac{2}{5} : 2\tfrac{3}{5} \text{ or } 17 : 13 \text{ is the ratio of the}$$

quantities; *i.e.*, $\frac{17}{30}$ of 1000 = $566\frac{2}{3}$ tons of coal, and $433\frac{1}{3}$ of slack.

$\therefore$ *Ans.* = $566\frac{2}{3} \times 3s. - 433\frac{1}{3} \times 2s. = £41\ 13s.\ 4d.$

(8) Whole number of oz. for consumption = $1200 \times 12 \times 7$. Consumed per week after reinforcement = 1800×7.

$$\therefore \textit{Ans.} = \frac{1200 \times 12 \times \cancel{7}}{1800 \times \cancel{7}} = 8 \text{ wks.}$$

(9) Here discount on $103\frac{3}{4}$ for 5 months at $3\frac{3}{4}$ = $£1\frac{9}{16}$. Now $1\frac{9}{16} : 774\frac{5}{8} :: £101\frac{9}{16} : £50{,}350\ 12s.\ 6d.$ *Ans.*

(10) Here in $4\frac{1}{2}$ minutes the three taps fill

$$\left(\frac{1}{24} + \frac{1}{10} + \frac{1}{27}\right) \times 4\tfrac{1}{2} = \frac{193}{240}. \quad \text{To be filled } 1 - \frac{193}{340} = \frac{47}{240};$$

$$\therefore \frac{47}{240} \div \frac{1}{24} = 4\tfrac{7}{10} \text{ minutes.}$$

(11) Total length of first train = 40 + 384 + 60 = 484 ft., and second = 669 ft. Now first train will pass over 669 ft. in $\frac{669 \times 60 \times 60}{40 \times 1760 \times 3} = 11\frac{71}{176}$ secs. But second train passes over 484 ft. in 11 seconds. $\therefore$ *Ans.* = $\frac{71}{176}$ secs.

(12) If *A* 3 to *B*'s 5, then $3\frac{1}{2}$ of $A = 5\frac{5}{8}$ of *B* or 6 of *C*; $\therefore$ 3 of $C = \frac{1}{2}$ of $5\frac{5}{8}$ of $B = 2\frac{11}{12}$; hence the *Ans.* $\frac{1}{12}$ of a mile.

(13) In taking the sovs. there is a gain of ·25 on 25 or 1 per cent., and in parting with them the loss is ·25 on 25·25 or

$$\frac{\frac{1}{4} \times 100}{25\frac{1}{4}} = \frac{100}{101} \text{ per cent.}$$

(15) By Chain Rule—

$$\begin{aligned} Ans. &= 434 \text{ sovs.} \\ 1 \text{ sov.} &= 25{\cdot}5 \text{ f.} \\ 5{\cdot}4 \text{ f.} &= 1 \text{ pi.} \\ 1 \text{ pi.} &= 5{\cdot}6 \text{ f.} \\ 26{\cdot}35 \text{ f.} &= 1 \text{ sov.} \end{aligned}$$

$$\therefore Ans. = \frac{434 \times 2550 \times 56}{54 \times 2635} - 434$$

$$= £435\tfrac{5}{9} - £434 = £1\tfrac{5}{9}$$

(16) See Ex. 8, p. 172 in *Arithmetic.*

W.

(1) See square root.

(2) See F. 3.

(3) £7 5*s.* 10*d.* ÷ 6*s.* 3*d.* = $23\frac{1}{3}$ square yards.

$$\therefore Ans. = \frac{£23\frac{1}{3} \times 9}{13\frac{1}{3}} = 15 \text{ ft. } 9 \text{ in.}$$

(4) Interest of £100 for 19 months = $\frac{1\cancel{00} \times 19 \times \cancel{3}}{\cancel{1200}} = 4\frac{3}{4}$

$$\therefore Ans. = \frac{£838 \times 100}{104\frac{3}{4}} = \frac{£838 \times 100 \times 4}{419} = £800$$

(5) $Ans. = \frac{£1298 \times 90}{99} = £1180.$

(6) Here $(30 + 20) \times 2 = 100$ ft. the circuit.

$$Ans. = \frac{100 \times 14{\cdot}193 \times 19d.}{240 \times 3 \times 1\frac{5}{6}} = \frac{\overset{4{\cdot}731}{\cancel{100} \times \cancel{14}{\cdot}193 \times 19 \times \cancel{6}}}{\underset{4}{\cancel{240} \times \cancel{3} \times 11}}$$

$$= \frac{47{\cdot}31 \times 19}{4 \times 11} = \frac{898{\cdot}89}{4 \times 11} = \frac{224{\cdot}7225}{11} = £20\ 8s.\ 7{\cdot}\dot{0}36\dot{d}.$$

(7) In a $3\frac{1}{2}$ per cent. stock at $81\frac{1}{4}$, an income of £$3\frac{3}{20}$ will be had from $73\frac{1}{8}$; ∴ gain on every £100 3 per cent. stock is $\frac{3}{20}$.

$$\therefore Ans. = £100 \times 4\tfrac{1}{2} \div \tfrac{3}{20} = £3000$$

(8) Here 17 : 16 :: 16 oz. : $15\frac{1}{17}$ oz. He gains $\frac{16}{17}$ on $15\frac{1}{17}$ *i.e.*, $(\frac{16}{17} \times 100) \div 15\frac{1}{17} = 1600 \div 256$ or $100 \div 16 = 6\frac{1}{4}$ per cent.

(9) $C = 300$, $B = 290\frac{1}{4}$, $A = 293\frac{216}{1188}$; ∴ *C's* mile = $(1760 \times 293\frac{216}{1188}) \div 300 = 1720$; ∴ $Ans. = 1760 - 1720 = 40$.

(10) See I. (7).

(11) Here 1 ton 2 cwt. 3 qrs. 4 lbs. = 2552 lbs. Now £26 11*s.* 8*d.* ÷ 2552 = 2½*d.* the gain per lb.; ∴ buying price was 1*s.* 8*d.* and a gain of 2½*d.* on 20*d.* = $\frac{1}{8}$ or 12½ per cent.; again, 112 × 20*d.* = £9 6*s.* 8*d.* cost per cwt.

(12) Here as the angle of an equilateral triangle is $\frac{2}{3}$ of a right angle, if we imagine the horse in the centre of a circle he will feed round a circle whose area is 6 times $\frac{1}{4}$ an acre or 1½ acres, the diameter of which is found thus: $D^2 \times \cdot 7854 = 1\frac{1}{2}$ acres.

$$\therefore D^2 = \frac{3 \times 4840}{2 \times \cdot 7854}, \text{ and } D = \sqrt{\frac{14520}{2 \times \cdot 7854}} = \sqrt{9243 \cdot 697478}$$

= 96·144. Now half of this is the radius = 48·072. *Ans.*

(13) 1 inch of the wire = $\frac{1}{30} \times \frac{1}{30} \times \cdot 7854$. ∴ *Ans.* = 1728 $\div \frac{7854}{9000000} = \frac{1728 \times 9000000}{7854 \times 1760 \times 36} = 31$ mls. 2 f. 3 yds. $2\frac{601}{1309}$ ft.

(14) Here average diameter = 63 in.

$$\therefore Ans. = \frac{63 \times 3 \cdot 1416 \times 9 \times 9}{1728} = 9 \text{ c. ft. } 479 \cdot 5848 \text{ c. in.}$$

(15) 11 minutes = 660 secs.; then 660 secs. of *A* = 663 of *B*. Now since there are 1440 minutes in a day, there were 1430 only in a day on the *A* clock.

Hence *Ans.* = $1440 - \frac{1430 \times 663}{660} = 1440 - 1436\frac{1}{2}$

3½ minutes, loss.

ERRATA.

NOTE.—Question LXIII., No. 33, *Key*, p. 87.—I prefer the following solution:—Time for 12 miles, whole journey, with and against wind = $\frac{6}{10}$ of 60′ + 50′ = 86′. If no wind, rate per hour = $8\frac{3}{5}$ miles. Hence time for journey if no wind = $8\frac{3}{5} : 12 :: 60' : 83\frac{1}{13}'$. Therefore wind retards him $86 - 83\frac{1}{13}' = 1\frac{2}{13}'$, or $\frac{6 \ m. \times 2\frac{2}{13}}{50}$

$= \frac{6 \times 1760 \times 98}{43 \times 50} = 481\frac{13}{215}$ yards.

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